

HubLine Impact Assessment, Mitigation, and Restoration

Annual Progress Report of the *Massachusetts Division of Marine Fisheries* to the Executive Office of Environmental Affairs

**Period Covered:
May 31, 2003-June 30, 2004**

Prepared by:

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September 1, 2004

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Executive Summary

The construction of a natural gas pipeline in Massachusetts Bay, outside of recommended time-of-year work windows, resulted in \$5 million in compensation to the Commonwealth of Massachusetts by Algonquin Gas Transmission Company for mitigation to damages to marine resources and habitat. A memorandum of agreement, signed on May 30, 2003 by the Executive Office of Environmental Affairs, Department of Environmental Protection, and the Department of Fisheries Wildlife and Environmental Law Enforcement, governs the expenditure of the award to the Division of Marine Fisheries. It defines a 5-year period for expenditure of the funds, partitions the compensation into a maximum of \$1 million for monitoring and assessment and \$4 million for mitigation and restoration, and defines a public process.

Public input was solicited during the prescribed period and a monitoring plan and a suite of mitigation/restoration proposals were developed with the aid of an inter-agency steering committee. The mitigation proposals include work in four areas: eelgrass restoration, habitat enhancement, anadromous fish restoration, and shellfish propagation. All mitigation efforts are planned for implementation during 2004-2008 and will include monitoring and evaluation of relative success in meeting program objectives.

Monitoring activities were initiated in June 2003 by Algonquin's contractors due to the need to evaluate the effect of surface laid pipe or open trench on the seasonal onshore migration of American lobster. The study did not report higher concentrations of lobsters on the east side of the pipe which would have indicated that the pipe was an impediment to inshore (westward) migration of lobsters. However, since back-fill plowing had already begun, results should be considered inconclusive.

Additional monitoring studies were initiated by the Division of Marine Fisheries in August 2003 with several additional localized sampling efforts. Marine Fisheries' staff undertook underwater video monitoring including diver transect surveying to describe and quantify biota in and near the trenches of three sections of exposed pipe off Boston. Algonquin's plan to bury these sections with stone raised concerns about the effect on fauna and flora in the trenches and adjacent natural habitat. SCUBA surveys provided baseline data for future recovery monitoring which indicated that significant changes in vegetation and re-colonization of crustaceans and finfish had occurred in a relatively short time since the pipe was laid.

During 2003 *Marine Fisheries* augmented its commercial lobster sea sampling in the general Massachusetts Bay area in order to evaluate potential impacts from construction on the Massachusetts Bay lobster fishery. Standardized catch rate trends will be updated and monitored during the HubLine study period.

Suction sampling of early benthic phase (EBP) lobsters also was conducted in the Massachusetts Bay area to help evaluate larval lobster settlement relative to previous years. Sampling was conducted using a diver-operated suction device. This time series will be updated annually for the duration of the HubLine Program and augmented with site-specific suctioning of impacted sediments on the pipeline pathway.

A ventless lobster trap sampling strategy was designed for implementation in the HubLine impact area and greater Massachusetts Bay; a survey projected to begin during FY-05. The use of ventless gear will extend lobster size structure information to the smaller sizes that do not normally occur in commercially-deployed vented traps. Trap placement will be stratified by

bottom sediment type and bathymetry. This survey will help to evaluate lobster abundance and size structure on the impacted HubLine pathway relative to non-impacted areas throughout Massachusetts Bay while taking into consideration the effects of depth and bottom sediment type.

Long term monitoring of the pipeline pathway began in March 2004 after the schedule of trench back-filling and leveling was projected to be completed. Post-construction assessment activities of the HubLine pathway are multi-faceted and are intended to address impacts from the construction and evaluate recovery. Consequently, in order to monitor changes in the disturbed area we undertook a sonar and video monitoring effort to provide post-construction baseline information. As-built coordinates of the pipeline pathway were acquired from Algonquin's subcontractor, TRC Environmental Corporation, and baseline imaging of the disturbed sediments using sonar and video equipment aboard the 65' NOAA R/V Gloria Michelle was initiated.

Sonar and video imaging indicate that the disturbed habitat along the 29.4-mile path has not yet been restored to pre-construction quality. There is a considerable amount of relief which is evident in elongated spoil piles which are 1-2m in elevation. Width of disturbed sediments along the pathway generally significantly exceeds estimates provided during the pre-construction review process and approach 25 m (75ft). This is an important consideration in the evaluation of the impact of future similar marine construction projects.

Overall, most of the back-filled trench, especially areas with cobble deposition or a cobble sand mix suggests early stages of flora and fauna colonization. The shallower sites appear to have more attached growth than the deeper sites. Finfish and crustaceans including lobsters were observed infrequently.

Potential future "monitoring posts" were selected from sonar imaging and represent an array of habitat types with which we can monitor recovery. A description of these sites via sonar records and preliminary general descriptions with accompanying ROV video accounts are presented.

HubLine Impact Assessment, Mitigation, and Restoration

***Marine Fisheries'* Annual Progress Report for Year 1**

May 31, 2003-June 30, 2004

I. Introduction

The "HubLine" natural gas pipeline was constructed by Algonquin Gas Transmission Company in Massachusetts Bay during 2002-2003. This 29.4 mile long, 24" to 30" diameter pipe runs from Salem/Beverly to Weymouth and is buried at a minimum depth of 3 ft. with several exceptions (Figure 1). Horizontal directional drilling, conventional dredging, jetting, plowing, and blasting were all part of the construction process and collectively, they were assumed to have exerted an impact on the marine environment and living resources. Depending upon the type of equipment used, the area of disturbed sediments along the pipeline pathway caused by trenching and back-filling varied to as wide as ~70ft.

Specific Time-Of-Year (TOY) work windows were defined in the permitting process by the reviewing agencies in order to minimize the impact of construction activities on e.g., migratory movements or spawning seasons and the associated vulnerability of eggs and larvae of various species. Exceeding recommended TOY's beyond 30 April 2003 and 31 May 2003 work window end dates resulted in monetary compensation to the Commonwealth by Algonquin for mitigation and restoration (\$5,000,000.00) for any short or long-term impacts to aquatic resources and habitat and for assessment. The Massachusetts Division of Marine Fisheries (*Marine Fisheries*) was the designated lead agency in receipt of these funds and with the responsibility to provide effective mitigation and/or restoration of aquatic resources and habitat.

A Memorandum of Agreement (MOA) with the Department of Environmental Protection and the Executive Office of Environmental Affairs, signed on 30 May 2003, determined that mitigation and restoration would be conducted during a 5-year program (Appendix A). The MOA indicates that of a total \$5,000,000.00 awarded to *Marine Fisheries* by Algonquin for impacts to the marine resources, \$1,000,000.00 is to be used for assessment and 4 million for mitigation and restoration. Of the \$1,000,000.00 established for assessment, DMF received \$900,000.00 since \$100,000.00 was spent by Algonquin on a recommended supplemental monitoring effort which included initial video monitoring work on the pipeline path prior to pipe burial to investigate the possible effect of exposed pipe on lobster migration.

II. Program Administration and Public Process

A HubLine Mitigation and Restoration Program Coordinator (Bruce T. Estrella) was assigned to administer the process and directives defined in the MOA and develop and manage a mitigation/restoration and monitoring/assessment program and associated costs. An administrative budget was prepared for operation and support of HubLine-related activities for the duration of the 5-year term of the MOA. Expenditure organization and accounting associated with the management of the \$4.9 million budget, designing, implementing, and supervising research projects, purchasing, contracting, and hiring are among the responsibilities of this program coordinator.

Duties were initiated with the development of an accounting system to monitor and collate expenses incurred by the HubLine Program. A *Marine Fisheries* internal steering committee was chosen to provide initial guidance to the HubLine mitigation and restoration program and the public process mandated by the MOA. An informational brief was drafted for committee discussion to provide members with the HubLine construction project background. This included assumed impacts to marine resources and habitat from the construction, funding granted to mitigate those impacts, the MOA which governs expenditures, a list of assessment, monitoring, mitigation, and restoration proposals recommended to date, and a timeline for our future activities.

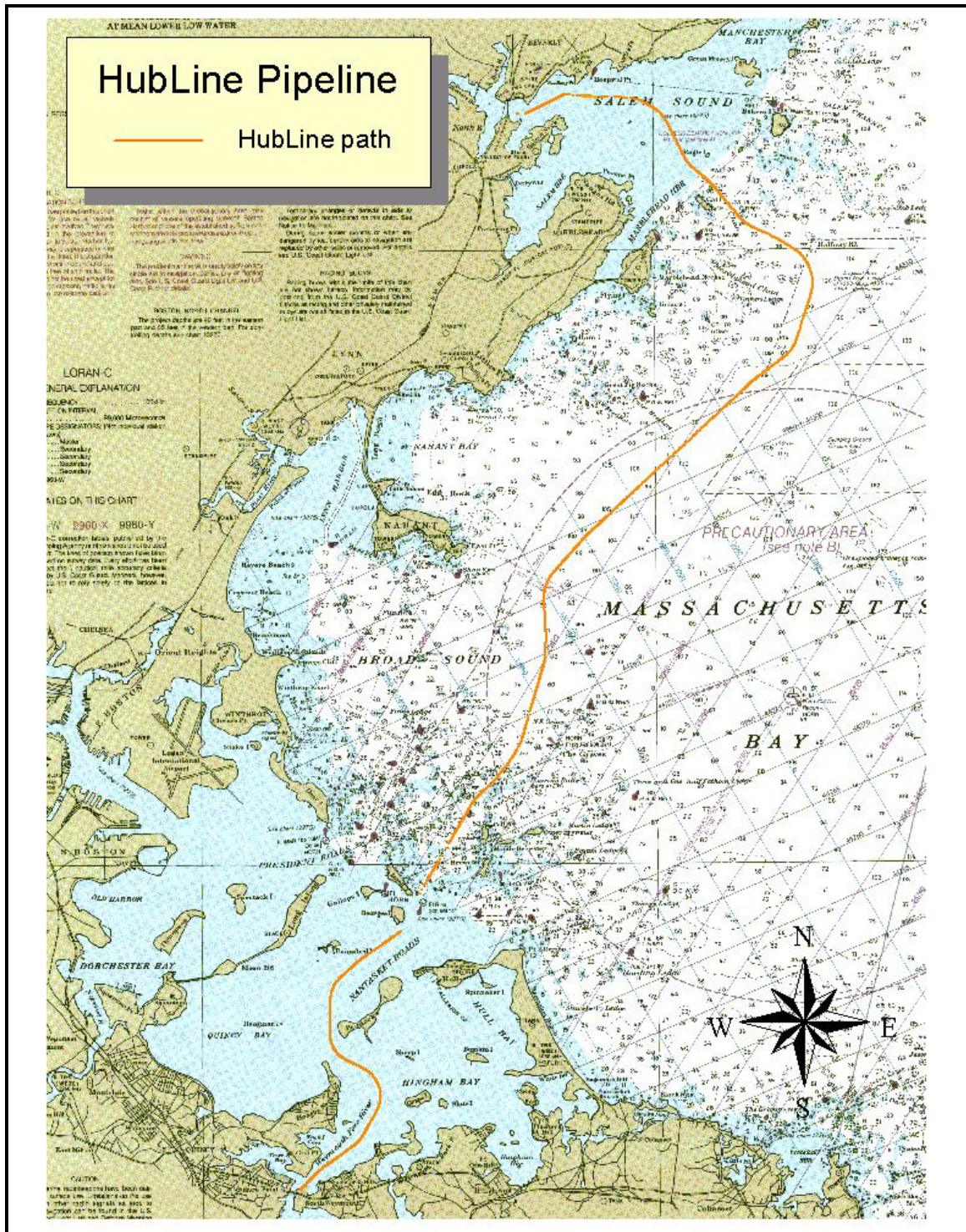


Figure 1. Route of HubLine natural gas pipeline in Massachusetts Bay.

As required in the MOA, a public process was implemented within six (6) months of the MOA's effective date of 30 May, 2003 to solicit input on mitigation/restoration project selection criteria and project ideas. We defined the public process to include a public announcement and comment period during October 28-November 28, 2003 and the creation of an Inter-Agency Steering Committee to seek input from interested stakeholders and relevant state and federal agencies. The Steering Committee, which included representatives of the MA Department of Environmental Protection, National Marine Fisheries Service, Coastal Zone Management, Environmental Protection Agency, Conservation Law Foundation, and Marine Fisheries Commission, met twice during winter 2003/2004 to help us define a mitigation/restoration work plan. On 23 December 2003, we presented an array of optional mitigation ideas to the Steering Committee. These were a product of a review of all available inter-agency documents and communications associated with the environmental review process for the HubLine construction, the scientific literature on mitigation and restoration studies, and contributions from key *Marine Fisheries*' project leaders (Internal Steering Committee) with expertise on specific resources. Ideas favored by the Committee were developed into full proposals which were reviewed by the Committee on 24 February 2004. The proposals include work in four areas: eelgrass restoration, habitat enhancement, anadromous fish restoration, and shellfish propagation. All mitigation efforts are planned for implementation during 2004-2008 and will include monitoring and evaluation of relative success in meeting program objectives.

III. Monitoring Activities

Assessment of impacts of pipeline construction began in June 2003. The exceeding of spring TOY work window end dates raised concerns about potential impacts to American lobster (*Homarus americanus*) and the associated fishery via interference with seasonal onshore migration of lobsters. This resulted in the need to evaluate the effect of surface laid pipe or open trench on the seasonal onshore migration of American lobster. Of the \$1,000,000.00 allocated to the Commonwealth for assessment, \$100,000.00 was spent by Algonquin on a contracted diver video and ROV survey of lobsters in the vicinity of the pipeline during a 12-day period in June and July, 2003, which was originally intended to occur prior to pipe burial. The study did not report higher concentrations of lobsters on the east side of the pipe which would have indicated that the pipe was an impediment to inshore (westward) migration of lobsters (Anonymous 2003). However, since back-fill plowing had already begun, results should be considered inconclusive.

Additional monitoring studies (Sections III A to III E, below) were initiated by *Marine Fisheries* in August 2003 with several localized sampling efforts. Long term monitoring of the pipeline pathway began in March 2004 after the schedule of trench back-filling and leveling was projected to be completed (Section III E, below).

III A. Transect Surveys of Unburied Pipe

Marine Fisheries' staff undertook underwater video monitoring including diver transect surveying to describe and quantify biota in and near the trenches of three sections of exposed pipe (two 500' and one 1800' section) off Boston on August 11, 2003 (Figure 2). Algonquin representatives had indicated that burial of these sections to the mandated depth was not possible due to ledge and they planned on covering them with stone. Concerns were raised because this was an unplanned activity for this time of year which could affect finfish or crustacean presence in adjacent natural habitat. In advance of this action, we devised and deployed a sampling strategy to evaluate the potential impact on fauna and flora which may have repopulated the area. A request was made to Algonquin's representatives to place marker buoys on the pipe sections in question to facilitate our locating the sections.

Our survey design included observational and video transects along the center of each pipe section and also parallel transects 30' to either side of center to provide an overview. Perpendicular, "across-pipe" 60' transects were also planned at 100' intervals to characterize the bottom sediments and enumerate finfish and invertebrates. Perpendicular transect length was established by doubling the projected 30' footprint of the fill (30' out from pipe center on each side).

Two ~ 500+ ft. sections were evaluated, but a dive on the third and longest section (1800+ ft) revealed that its marker buoy was not dropped on the exposed portion of the pipe. At this point the current was very strong and the fog was too thick to risk drift dives at this location particularly with boat traffic in the area.

This monitoring effort indicated that significant changes in vegetation and re-colonization of crustaceans and finfish had occurred in a relatively short time since the pipe was laid. Descriptions of diver and video observations are included in Appendix B.

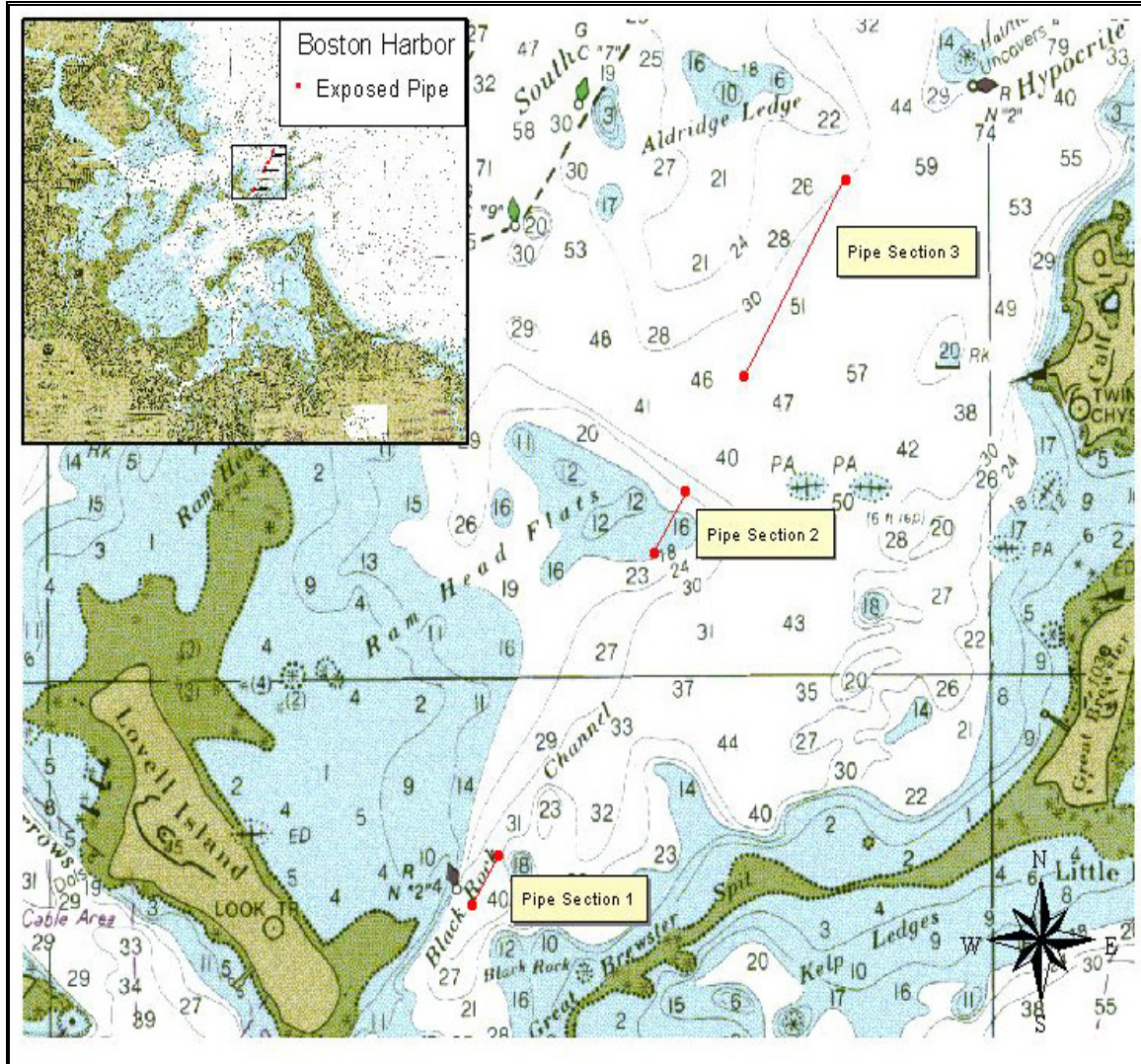
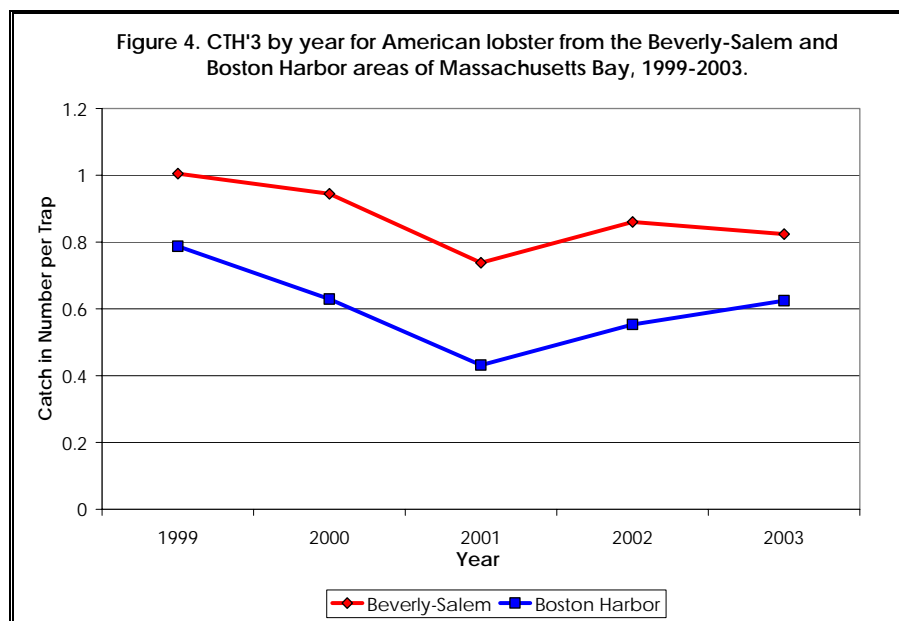
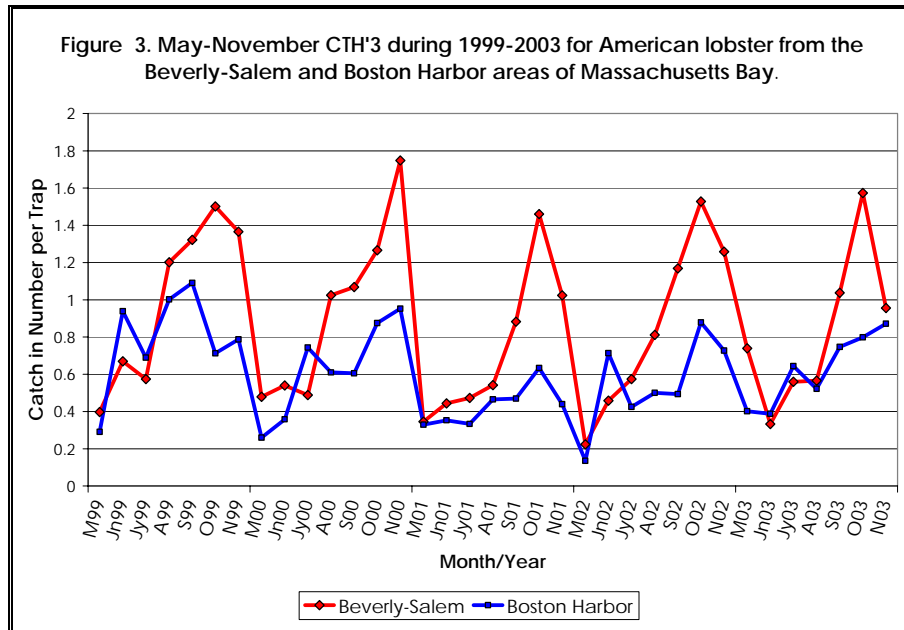


Figure 2. Location of three sections of exposed pipe targeted for DMF SCUBA surveys, August 11, 2003.

III B. Enhanced Commercial Lobster Sea Sampling in Massachusetts Bay

Marine Fisheries augmented its commercial lobster sea sampling in the general Massachusetts Bay area and in the MA portion of the southern Gulf of Maine in order to evaluate potential impacts to the Massachusetts Bay lobster fishery. In response to this concern two contract Fisheries Technicians were hired to conduct this work. Their efforts nearly doubled the usual number of commercial sea sampling trips in the area of concern during 2003.

The marketable catch in number of lobster per trap, 1999-2003, standardized to 3 set-over-days (CTH'₃; Estrella and McKiernan 1989) was calculated by month (May-November) during 1999-2003 for the Massachusetts Bay areas of Beverly-Salem and Boston Harbor (Figure 3). Annual CTH'₃ for the two areas are displayed in Figure 4. These trends will be updated and monitored during the HubLine study period.



III C. Suction Sampling of Early Benthic Phase Lobsters

Suction sampling of early benthic phase (EBP) lobsters was conducted in the Massachusetts Bay area to help evaluate larval lobster settlement relative to previous years (Figure 5). Sampling was conducted using a diver-operated suction device. Sampling design and equipment was standardized according to the strategy defined by Wahle (1993). The suction device consisted of a 3" PVC lift tube supplied with air from a SCUBA tank. Samples were air-lifted into a 1.5 mm mesh nylon bag attached to the upper end of the suction tube. At each site, 0.5 m² quadrats were haphazardly placed on the substratum at least 2 m apart. Large boulders and large patches of sand were avoided. Sampling a quadrat in cobble habitat involved slowly moving the lift tube over the bottom while carefully moving rocks individually (Figure 6). Rocks were removed until no interstitial spaces remained.

Experimental EBP sampling by diver operated suction equipment in MA coastal waters began in 1995. Due to the short length of the time series, indices have yet to be related directly to commercial catch rates or landings. The effects of natural mortality occurring between settlement and recruitment to commercial size are unclear, making it difficult to interpret trends and their effect on the fishery.

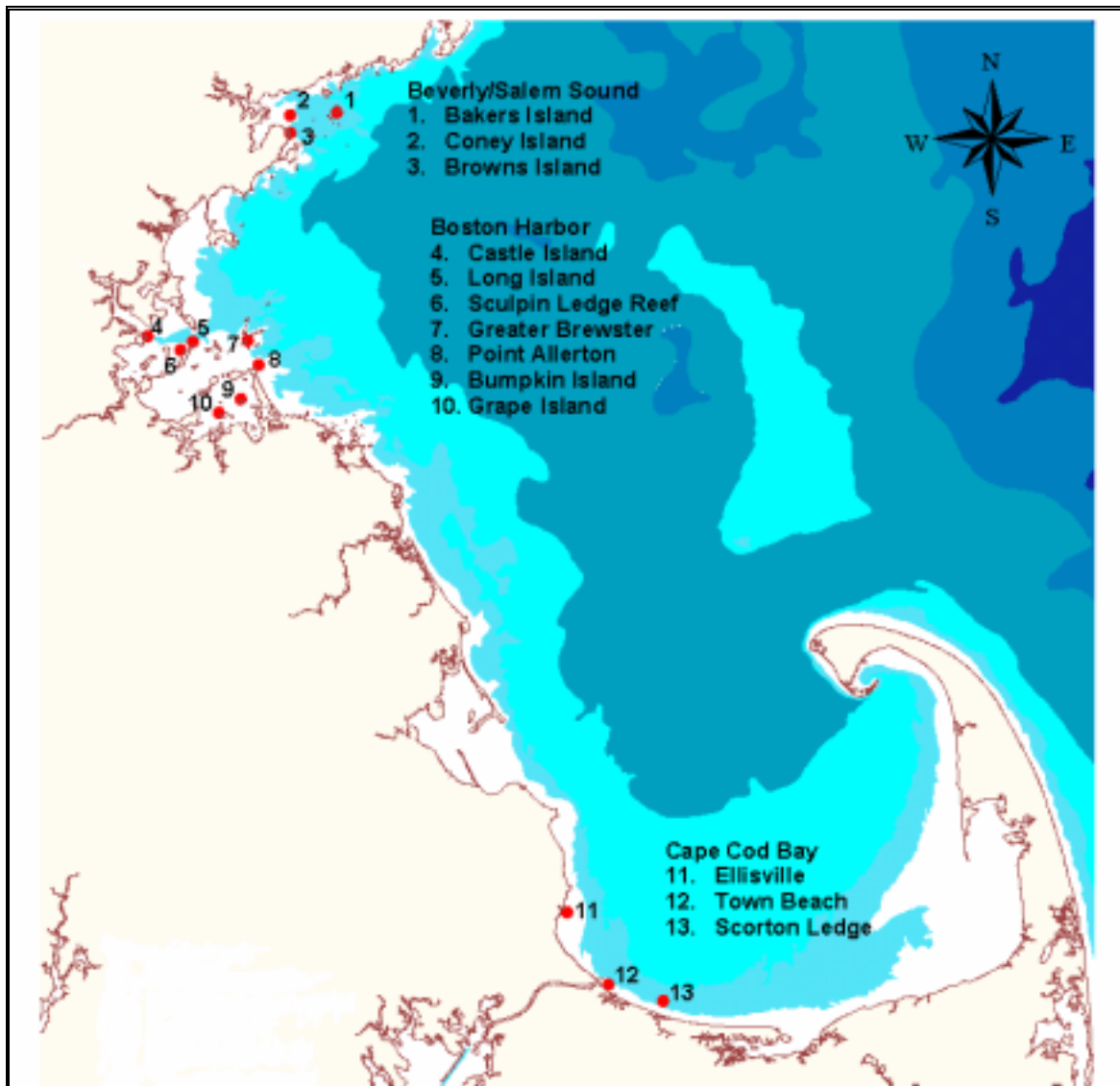


Figure 5. Suction sampling sites occupied in Massachusetts coastal waters north of Cape Cod, 2003.

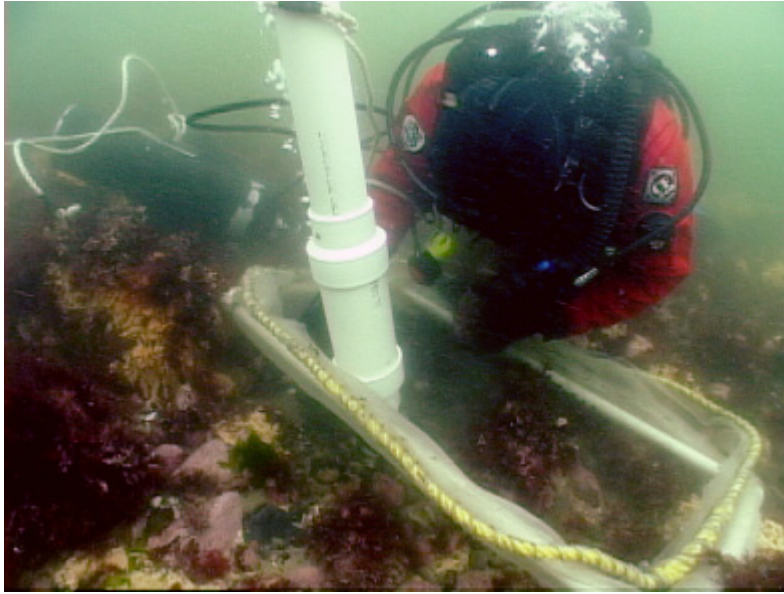
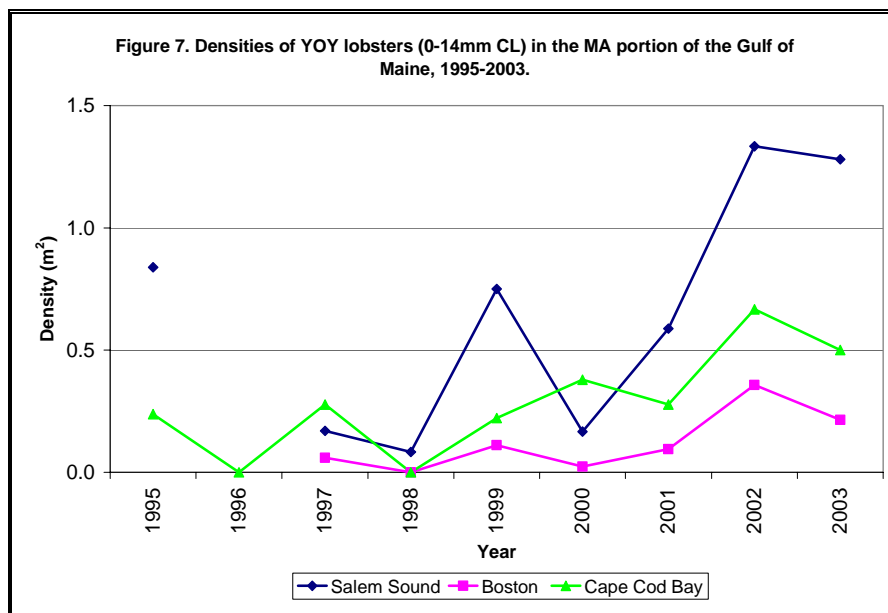
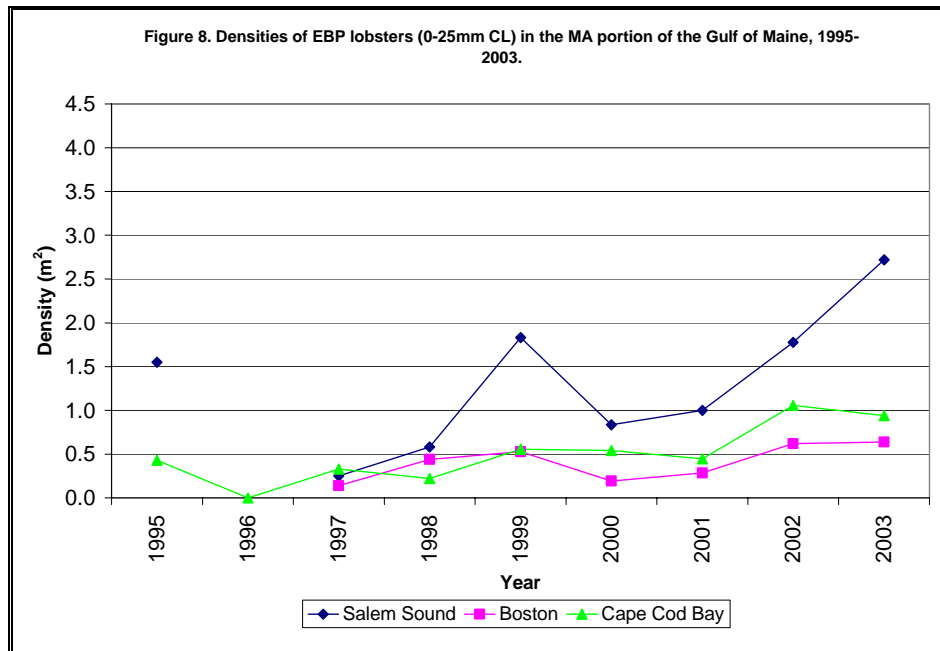


Figure 6. View of typical SCUBA suctioning operation within a 1/2 m² quadrat.

The 2003 densities of young-of-the-year (YOY) lobsters (<14mm CL) from regions in the vicinity of the HubLine construction, i.e., Salem Sound, Boston Harbor, and Cape Cod Bay, fluctuated downward from 2002 to 2003 in all three areas (Figure 7). The densities of early benthic phase lobsters (0-25mm CL) increased in Salem Sound and remained similar in Boston Harbor and Cape Cod Bay areas (Figure 8). Interpretation of these data should be done cautiously since they are characterized by high variances.

This time series will be updated annually for the duration of the HubLine Program and augmented with site-specific suctioning of impacted sediments on the pipeline pathway. These additional studies require SCUBA-trained personnel who will not be available until mitigation proposals are initiated and associated personnel hired.





III D. Ventless Trap Survey

Experimental trap sampling represents an additional means of investigating impacts to American lobster. A ventless lobster trap sampling project was designed with the assistance of *Marine Fisheries* staff for implementation in the HubLine impact area and greater Massachusetts Bay. The use of ventless gear will extend lobster size structure information to the smaller sizes that do not normally occur in commercially-deployed vented traps. Trap placement will be stratified by bottom sediment type and bathymetry. This survey will help to evaluate lobster abundance and size structure on the impacted HubLine pathway relative to non-impacted areas throughout Massachusetts Bay while taking into consideration the effects of depth and bottom sediment type. This survey is projected to begin during FY-05.

III E. Acoustic and Optical Surveys of Pipeline Pathway

Post-construction assessment activities of the HubLine pathway are multi-faceted and are intended to address impacts from the construction and evaluate recovery. We are involved in a long term effort through specific assessment and monitoring plans which, in some cases, are associated with mitigation projects. These will help us to understand the broad range of potential impacts which may have occurred.

The video work which our staff conducted in August, 2004 on several exposed sections of the pipe indicated that significant changes in vegetation and re-colonization had occurred in a relatively short time. Consequently, in order to monitor changes in the disturbed area and recovery we undertook a sonar and video monitoring effort to provide post-construction baseline information. As-built coordinates of the pipeline pathway were acquired from Algonquin's subcontractor, TRC Environmental Corporation, and baseline imaging of the disturbed sediments using sonar and video equipment aboard the 65' NOAA R/V Gloria Michelle was initiated.

Acoustic and Optical Methodology

Surveys began after the schedule of pipeline trench filling and leveling was completed by Algonquin and its contractors (February 2004). A dual camera system was set up for surveillance of the pipeline pathway

and DVD recording hardware and GPS video-overlay electronics were interfaced. Video data assist in the ground-truthing of sonar records and both will help us to monitor succession and recolonization of the disturbed sediments. Diver surveys will also be conducted to complement this work. Multi-year assessments will be made of the recovery of species diversity on the disturbed sediments relative to control sites. This sediment imaging effort will also contribute to the site selection process for the naturalistic reef proposal.

Three surveys were conducted along the pipeline pathway during March 1-8, April 1-9, and June 14-19, 2004 using the R/V Gloria Michelle as a research platform. The vessel was operated from the Pt. Allerton USCG Base. Consultant H. Arnold Carr, American Underwater Search and Survey, Ltd. (AUSS), conducted the sonar surveys and supervised the video sled and ROV surveys. The intent was to survey the disturbed sediments and biota along the entire pipeline pathway and ultimately define a series of specific sites with unique characteristics, representing various sediment types, which would serve as future monitoring posts for evaluating recovery.

The suite of equipment operated from the research vessel included the following:

Navigation: Vessel's DGPS and a Hypack Max program on a laptop computer

Survey: EG&G DF1000 dual frequency digital sonar in the 500kHz mode (March)

Edgetech 272 dual frequency analog sonar in 500kHz mode (March and April)

Benthos C3D bathymetric side scan sonar (March)

DMF's one and two camera system mounted to drift and on an AUSS towfish (March, April, June)

Benthos MiniRover Mark II ROV (June).

Each towed survey system was deployed separately. This was not ideal because it increased the amount of data post-processing needed to match specific video footage to the broader field of view generated by sonar imaging. Every hour of video footage required a minimum of one hour of viewing at the lab. The planned purchase of an underwater vehicle capable of operating with multiple sensors will resolve this problem.

The survey area was confined to a minimum operating depth of about 20ft MLW, therefore each terminus of the underwater pipeline was not thoroughly surveyed. Certain locations at the mouth of Boston Harbor were not surveyed because they were in shallow rocky areas that prevented safe navigation and towing of equipment.

The two-camera system mounted on a sled did not have functional GPS overlay during the March cruise. To correct this we related the location information from field logs to the video counter/timer and manually dubbed the coordinates onto the tapes. The electronic overlay system was fully operational during April and June cruises.

Preliminary Results-Sonar and Video Sled

The sonar and video survey of the HubLine pathway was initiated on 1 March, 2004 by A.Carr and *Marine Fisheries'* Conservation Engineering personnel. Most of the HubLine was insonified by side scan sonar during March and April cruises (Figure 9).

The March sonar and video surveys revealed about 150 feet of trench in Boston Harbor which Algonquin and its sub-contractors did not back-fill as required by permit (Figure 10).

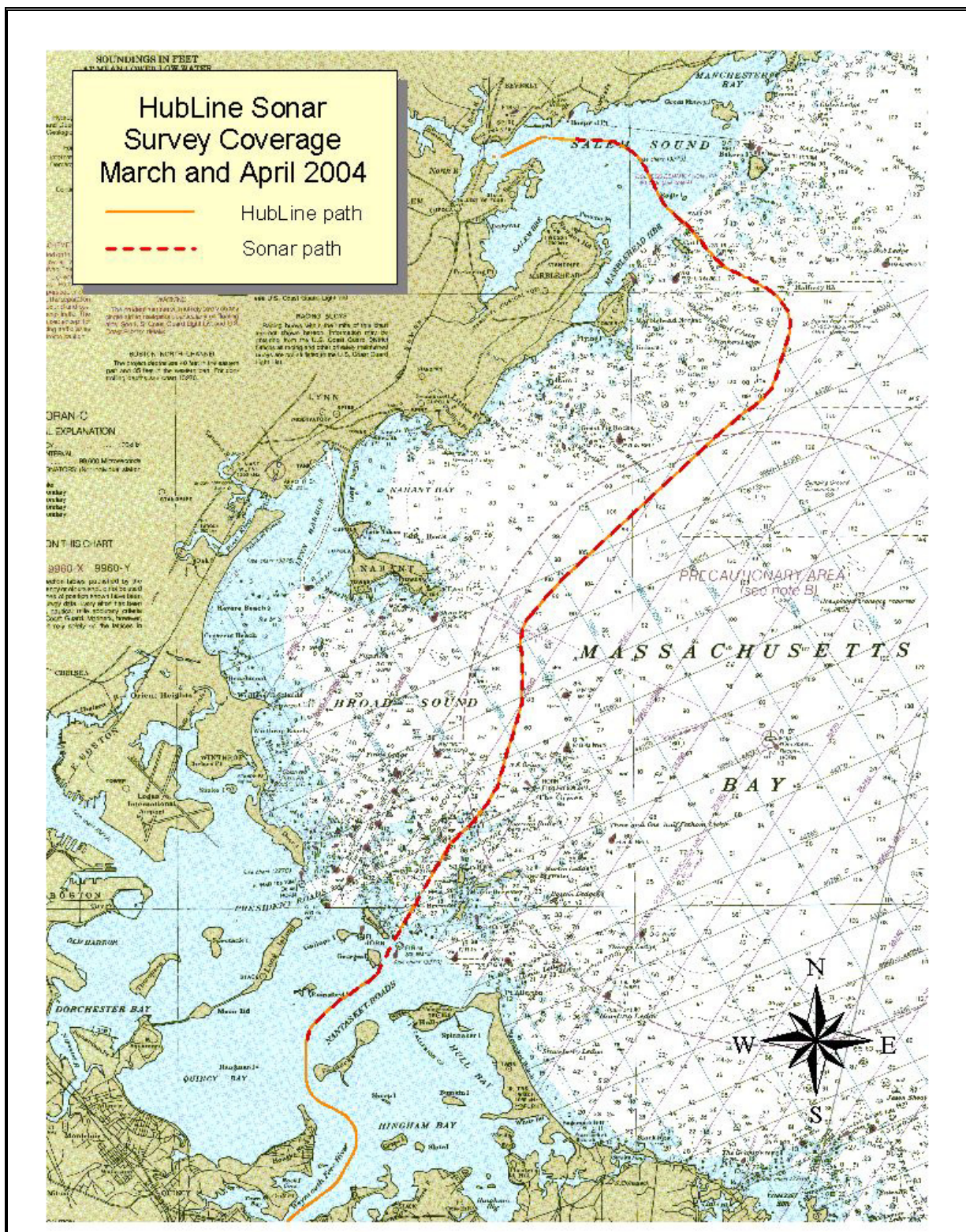


Figure 9. Map of sonar survey area occupied during March and April HubLine cruises, 2004.

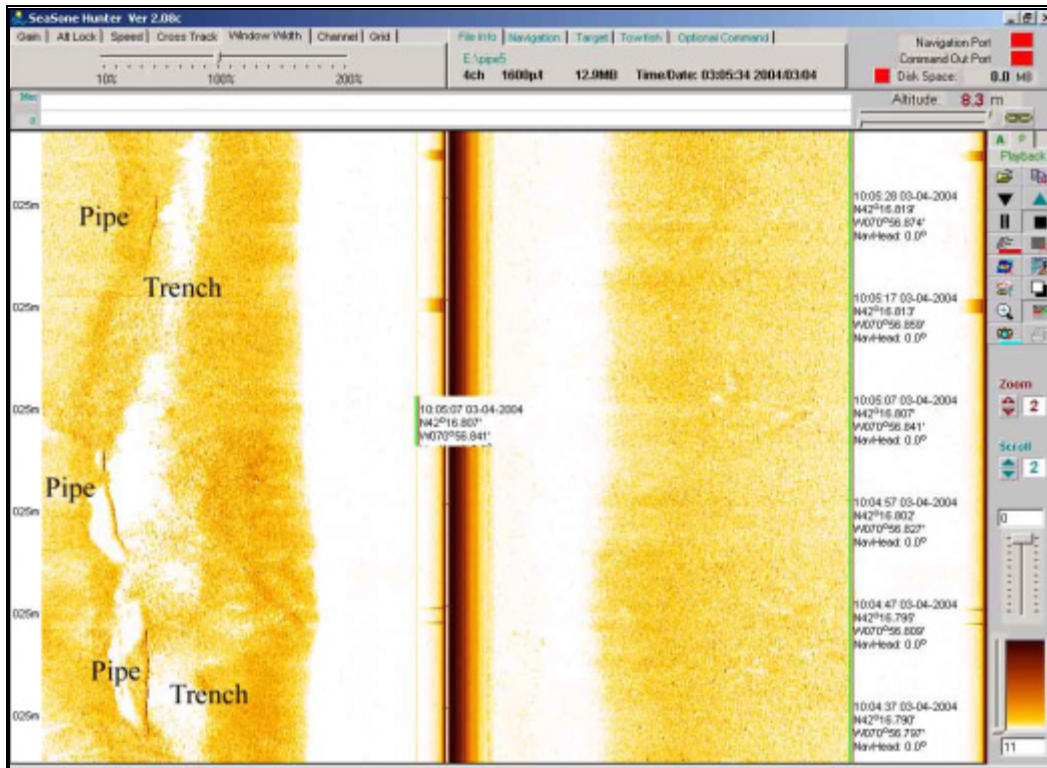


Figure 10. Sonar image of exposed HubLine pipe in an incompletely back-filled trench, March 4, 2004.

Sonar and video imaging indicate that the disturbed habitat along the 29.4-mile path has not yet been restored to pre-construction quality. Also, width of the area of disturbed sediments along the pathway generally exceeds estimates provided during the pre-construction review process and approaches 25 m (75ft). This is important information relative to evaluation of the impact of future similar marine construction projects. There is a considerable amount of relief which is evident in elongated spoil piles which are 1-2m in elevation. Figure 11 provides an example of this. It is conceivable that soft-bottom sediments which are disturbed in this manner may be modified and/or leveled by currents and storm surge (Figure 12). However, areas with comparatively low current velocity or deeper water sediments which are less affected by strong winds, particularly hard bottom, e.g., cobble sediments, may not recover naturally. This needs to be considered for future projects of this nature. Other locations along the back-filled pipeline trench which received fill and represent a complex environment provide opportunities for future monitoring efforts (Figure 13).

Sonar and video sled imaging were the principal applications intended for the March, April, and June surveys (Figure 14), but the intended emphasis was primarily on video. Video imagery was attempted in more than three locations during the April survey, however a northeast storm, swells, and heavy rains prior to and during the survey prevented successful deployment of the video system in both a drift and a towed mode. The rain is suspected of lowering underwater visibility to equal or less than two feet in the more inshore survey areas. The swell caused the video towfish assembly to move vertically in the water column. Very low underwater visibility concomitant with the unstable vertical movement of the towfish precluded much of the deployment of the video towfish system during the April survey period. The June 2004 video survey shows a considerable amount of the disturbed HubLine pathway at depths greater than 20ft MLW. These views were targeted at sites that were selected from sonar records and some video acquired during the March 2004 survey.

Overall, most of the back-filled trench, especially areas with cobble deposition or a cobble sand mix suggests early stages of flora and fauna colonization. The shallower sites appear to have more attached

growth (bryozoans and hydroids) than the deeper sites. Finfish and crustaceans, including lobsters were observed infrequently.

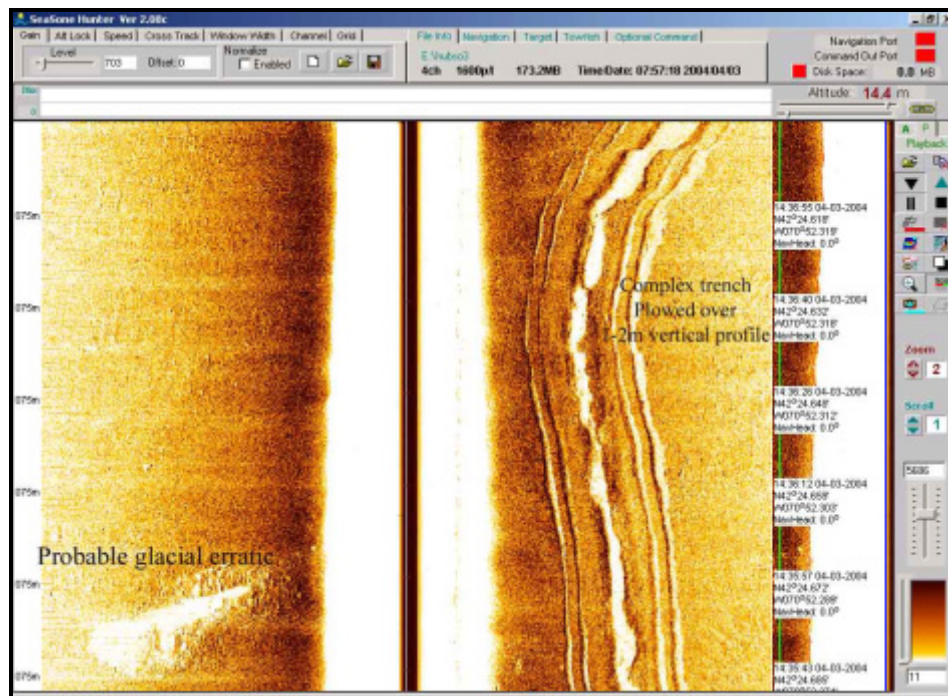


Figure 11. Example of significant relief on back-filled trench of HubLine pipeline, April 3, 2004.

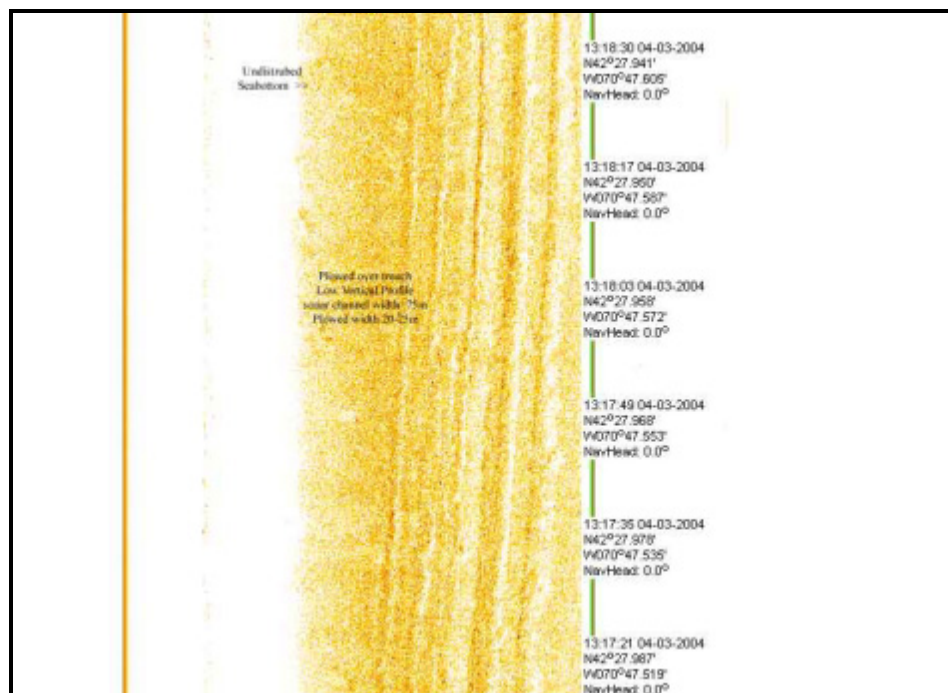


Figure 12. Sonar image of soft sediment back-filled area of HubLine path with low vertical relief.

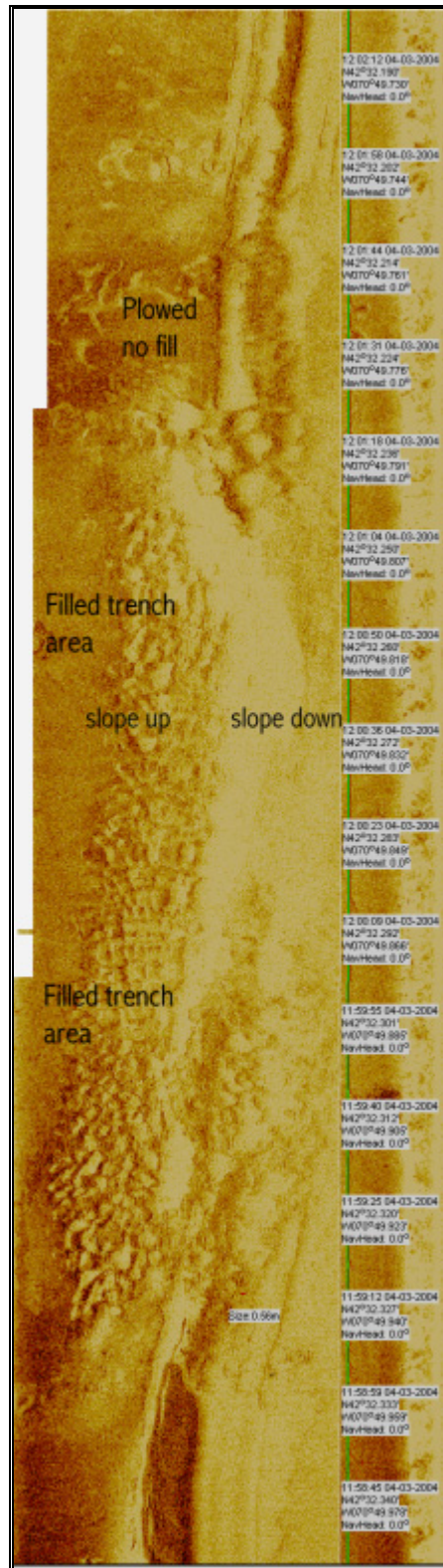


Figure 13. Sonar image of complex environment along HubLine pipeline trench which depicts an area of fill with plowed areas on either side.



Figure 14. Video sled survey conducted along HubLine pathway during March and June, 2004.

Preliminary Results-Sonar and ROV Dives

Fourteen ROV dives were conducted during June 15-17, 2004 at sites established on the basis of our previous sonar surveys. These sites are intended as potential future "monitoring posts" (Figure 15) and represent an array of habitat types, but are not yet considered to be a complete set at this time. A significant amount of imaging data has been collected to date and further analysis may generate additional locations of interest to monitor recovery. A description of these sites via HubLine sonar records taken by AUSS and preliminary general descriptions with accompanying ROV video accounts are displayed in Appendix C below. All sonar records are taken at a frequency of 500kHz, unless mentioned otherwise.



Figure 15. ROV dives conducted along HubLine pathway during June 15-17, 2004.

IV. Status of Mitigation and Restoration Projects

Mitigation and restoration work was not initiated in late FY-04 as planned. The review and approval process for associated proposals by the MOA parties of DEP and EOEA extended into FY-05.

The limited period for harvesting and transplanting eelgrass raised concerns that delays in hiring personnel by May, 2004 would affect Eelgrass Restoration Project goals in FY-05. In anticipation of delays, MassGIS eelgrass areal coverage was overlaid on Massachusetts Bay nautical charts with town water boundaries to determine municipal responsibility for each meadow. The Program Coordinator contacted shellfish constables and conservation commissions from greater Boston Harbor area towns of Boston, Winthrop, Hull, Hingham, Weymouth, and Quincy regarding our intent to harvest and transplant submerged aquatic vegetation (SAV). All constables were called and their respective town conservation commissions received a letter of introduction, a description of work to be accomplished, and a request for input on local permitting guidelines and requirements.

Short-term contract work was initiated to begin the suitable transplant site-selection process. Dr. Ryan Davis was contracted to assist in the collation and evaluation of available Boston area environmental data sets. Water quality, sediment type, depth, relative exposure index (REI), historical and current SAV distribution data layers were acquired from various agencies and included in a preliminary GIS analysis. Data tables displaying existing conditions where eelgrass exists were generated along with a data summary report which provided a preliminary transplant suitability index.

A formal, comprehensive GIS analysis of all data layers was initiated with the help of MADMF Research Analyst Micah Dean. This analysis will be a valuable asset to the Eelgrass Restoration Project. It assigns a suitability rating to all data, combines them by calculating a multiplicative index to accept or eliminate a potential site, and it can be updated as new environmental data are collected.

Acknowledgements

Gratitude is extended to H. Arnold Carr, AUSS for his work in conducting acoustic surveys and overseeing video monitoring activities at sea, to MADMF Conservation Engineering personnel Mark Szymanski and Mike Pol for video equipment configuration and sled operation, to Steve Voss for his help with GIS mapping, field assistance, and video post-processing, and to Kate Taylor for graphics. Other MADMF projects contributed data and/or SCUBA assistance: Coastal Lobster Investigations and Environmental Impact Assessment. David Taylor and Ken Keay, MWRA kindly provided environmental data, and Charlie Costello, DEP contributed historical SAV distribution information.

Literature Cited

- Anonymous 2003. HubLine Pipeline Project Supplemental Monitoring Report, Lobster Assessment. Prepared for Duke Energy Gas Transmission (Algonquin Gas Transmission Company) by TRC Environmental Corporation and Normandeau Associates, Inc. November 2003, 23 pages.
- Estrella, B. T. and D. J. McKiernan. 1989. Catch-per-unit-effort and biological parameters from the Massachusetts coastal lobster (*Homarus americanus*) resource: description and trends. NOAA Tech. Rep. NMFS 81. 21 p.
- Wahle, R. A. 1993. Recruitment to American lobster populations along an estuarine gradient. *Estuaries* 16(4):731-738.

APPENDIX A:

**MEMORANDUM OF AGREEMENT
between the
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS;
the DEPARTMENT OF ENVIRONMENTAL PROTECTION;
and the
DEPARTMENT OF FISHERIES, WILDLIFE & ENVIRONMENTAL LAW
ENFORCEMENT**

I. Parties

This Memorandum of Agreement ("MOA") is made as of this 30th day of May, 2003 between: (1) the *Executive Office of Environmental Affairs ("EOEA")*; a secretariat of the executive branch of the Commonwealth, established pursuant to M.G.L. c. 21A, s.1, with supervisory authority over the state agencies under EOEA, having its principal place of business at 251 Causeway Street, Suite 500, Boston, MA 02114; (2) the *Department of Environmental Protection ("DEP")*, an agency of the Commonwealth of Massachusetts under EOEA established pursuant to M.G.L. c. 21A, s.7, having its principal place of business at One Winter Street, Boston, Massachusetts 02108 and (3) the *Department of Fisheries, Wildlife & Environmental Law Enforcement ("DFWELE")*, an agency of the Commonwealth of Massachusetts under EOEA established pursuant to M.G.L. c. 21A, s.7, having its principal place of business at 251 Causeway Street, Suite 400, Boston, MA 02114. EOEA, DEP and DFWELE may hereinafter be collectively referred to as the "Parties" in this MOA.

II. Background and Purpose of the MOA

1. The HubLine project (the "Project") being constructed by the Algonquin Gas Transmission Company ("Algonquin") entails the installation of 29.4 miles of 30 inch diameter pipe, beginning in the municipalities of Salem and Beverly, MA where the pipe connects with the Phase III project of the Maritimes & Northeast Pipeline, L.L.C. and terminating in the municipality of Weymouth, MA. The Project pipelines will typically be buried between 3 to 10 feet below the sea floor, and will traverse Beverly Harbor, Salem Sound, Massachusetts Bay, Broad Sound, Quincy Bay, and the Fore River. Consequently, among a range of other federal, state and local permits and approvals, the Project activities required Algonquin to obtain a Section 401 Water Quality Certification and a Chapter 91 License from DEP pursuant to the above referenced statutes and regulations.

2. DEP issued its Water Quality Certification for the Project on August 16, 2002, and the final Chapter 91 License on September 26, 2002. Both of these DEP permits include a detailed schedule of construction activities and associated Time of Year ("TOY") work windows that were established by DEP with input from EPA, NOAA's National Marine Fisheries Services, and DFWELE's Division of Marine

Fisheries ("DMF"). See Condition 17 of the Water Quality Certification and Special Condition No. 4 of the Chapter 91 License. The purpose of the TOY windows is to minimize adverse environmental impacts to fisheries resources and habitat that will be affected by the construction of the Project, including multiple fisheries passage, spawning, development and/or sediment activities that are not discrete events with set end points.

3. Algonquin has commenced construction of the pipeline and, among other steps, has completed laying the pipeline on the seabed along the entire route in preparation for burial and has lowered the pipeline into an open trench along major portions of the route. At Algonquin's written request, DEP approved, with conditions, two minor time extensions pursuant to Condition 17 of the Water Quality Certification and Special Condition No. 4 of the Chapter 91 License. See the Amended Water Quality Certification dated March 27, 2003 and two DEP letters dated April 3, 2003 and April 10, 2003.

4. In a letter dated April 17, 2003, Algonquin requested DEP to approve the continuation of certain Project activities significantly beyond the applicable TOY work window end dates of April 30, 2003 and May 31, 2003, as applicable, in order to complete the pipeline during this construction season. DEP, after consultation with DMF and EPA, determined that, on balance, there would be less environmental impact to authorize Algonquin to continue Project activities beyond the April 30, 2003 and May 31, 2003 end dates, subject to additional conditions and substantial related mitigation, rather than to require Algonquin to halt construction until it can be resumed at a later time. Among the primary considerations supporting its determination, DEP is seeking to avoid and/or minimize impacts from the unburied portions of the pipe to the seasonal inshore lobster migration. DEP further concluded that benthic communities are likely now developing along the pipeline, including burrowing by winter flounder, lobster and crabs, which would be destroyed if work resumed at a later date, and that such intra-annual cumulative impact would likely delay recovery of habitat functions and values.

5. On May 9, 2003, DEP and Algonquin reached an agreement in principle pursuant to which DEP agreed to exercise enforcement forbearance regarding the continuation of work by Algonquin that falls outside the TOY windows contained in the above referenced Water Quality Certification and Chapter 91 License contingent upon DEP and Algonquin entering into an administrative consent order ("Consent Order") by May 16, 2003 to (a) address and condition further work by Algonquin outside the existing TOY windows, (b) require Algonquin to provide \$5 million to fund additional mitigation activities, and (c) impose stipulated penalties for any future noncompliance with the Consent Order. DEP and Algonquin were not able to reach closure on all of the final terms and language of the ACO. However, in view of the progress made on the ACO, DEP agreed on May 16, 2003 to extend its exercise of enforcement forbearance to May 21, 2003, and then one final time, to May 23, 2003.

6. DEP and Algonquin entered into a final Consent Order on May 23, 2003. Under the Consent Order, Algonquin shall make a total contribution of \$5,000,000 to the Commonwealth for the purposes of assessing and providing appropriate mitigation and restoration for any short or long term impacts to aquatic resources and habitat that may be associated, directly or indirectly, with Algonquin's continuation of Project activities beyond the April 30, 2003 and May 31, 2003 TOY work window and dates. More specifically, on the effective date of the Consent Order, Algonquin shall contribute the \$4.9 million to *The Commonwealth of Massachusetts Marine Mammals and Fisheries Research and Conservation Trust (hereinafter the "Trust Monies")*, an expendable trust previously established by DMF to accept mitigation funds provided by Algonquin pursuant to the Water Quality Certification.

7. The Consent Order requires that the Trust Monies shall be used for the purposes described above. The Consent Order further states that in developing the criteria and procedure for determining appropriate mitigation and/or restoration projects to be funded from the Trust Monies, DMF shall undertake a public review and comment process and seek the input of interested stakeholders and relevant state and federal agencies. DMF shall thereafter select all work, including mitigation and/or restoration projects, in accordance with the criteria established pursuant to the above process.

8. EOEa, DEP and DFWELE have concluded that an MOA between the Parties is necessary in order to further the above described purposes of the Consent Order and to ensure that the Trust Monies shall be used to effectively mitigate and/or restore any short or long term impacts to aquatic resources and habitat that may be associated, directly or indirectly, with Algonquin's continuation of Project activities as authorized in the Consent Order.

III. Terms of the MOA

NOW, THEREFORE, for the reasons set forth above, EOEa, DEP and DFWELE agree as follows:

1. Of the total \$5 million contribution made by Algonquin pursuant to the Consent Order, no more than \$1 million will be expended for assessment and/or monitoring activities. Included within this \$1 million limit is no more than \$100,000 of the total \$5 million contribution to be credited to the cost of Algonquin's implementation of a Supplemental Monitoring Plan during the implementation of the Work authorized in the Consent Order.

2. The Parties reaffirm that, as provided in the Consent Order, DMF shall develop a criteria and procedure for determining appropriate mitigation and/or restoration projects to be funded from the Trust Monies. More specifically, the Parties, pursuant to this MOA, agree that no later than six (6) months from the effective date of this MOA, DMF shall complete a public review and comment process and seek

the input of interested stakeholders and relevant state and federal agencies in establishing a project selection criteria. The Parties further agree that any such project selection criteria shall retain and use the basic hierarchy of mitigation/restoration preferences described in Paragraph 3 below. DMF shall thereafter select all work, including mitigation and/or restoration projects, in accordance with the criteria established pursuant to the above process. In addition, the final project selection criteria developed by DMF pursuant to the above process shall be subject to the approval of EOEA and DEP.

3. Hierarchy of Mitigation/Restoration Preferences. The Parties agree that the marine resources (listed in alphabetical order) receiving the greatest amount of impact from the Project are as follows:

Anadromous fish runs (i.e. – alewives, shad, herring)
Atlantic Cod
American lobster
Eelgrass
Blue Mussels
Hard-bottom encrusting community
Ocean Quahog
Sea Scallop
Soft-bottom benthic infaunal community
Softshell clam
Surf clam
Winter flounder
Yellowtail flounder

The Parties further agree that the final project selection criteria shall retain and use the following basic hierarchy of mitigation/restoration preferences:

1. *On Site/In Kind:* Projects proposing to restore one or more of the specific affected resources listed above within the footprint or immediate vicinity of the impact areas will be given the highest priority for funding.

2. *In Kind/off Site:* Projects proposing to restore one or more of the affected resources listed above within the greater Massachusetts Bay system, but removed from the impact areas shall be given the 2nd priority for funding.

3. *On Site/Out of Kind*: Projects proposing to restore marine resources not on the affected resource list above, but within the footprint or immediate vicinity of the impact areas shall be giving the 3rd priority for funding.

4. *Off Site/Out of Kind*: Projects proposing to restore marine resources not on the affected resource list above and removed from the project area will receive the lowest priority for funding.

In addition, the project selection criteria shall consider the probability of success and technical feasibility of any particular mitigation and/or restoration proposal.

4. Prior to the final selection of a project in accordance with the established criteria, DMF shall seek public review and comment and the input of interested stakeholders and relevant state and federal agencies. In addition, the final selection of a project in accordance with the established criteria shall be subject to the approval of EOEA and DEP. DMF shall begin funding mitigation and/or restoration projects in accordance with this MOA within eighteen (18) months from the effective date of this MOA, and expend the Trust Monies in accordance with this MOA on assessment activities and mitigation and/or restoration projects within five (5) years from the effective date of the MOA.

5. On an annual basis, DMF shall submit a written report to EOEA detailing the progress of and expenditures related to assessment activities and mitigation and/or restoration projects funded from the Trust Monies, and provide a copy of the report to DEP at the same time.

6. The Parties agree that if the Secretary of EOEA determines there is significant non-performance with the provisions of this MOA, the Secretary shall have the authority to take any remaining funds of the Trust Monies and establish a new funding and management mechanism that will meet the spirit and intent of the above described requirements of the Consent Order and this MOA.

7. EOEA, DMF and DFWLE agree to cooperate with each other reasonably, actively and in good faith to effectuate the provisions of this MOA. The Parties hereby initially appoint the following as their Authorized Representatives:

- EOEA: Stephen Pritchard
Executive Office of Environmental Affairs
251 Causeway Street, Suite 500
Boston, MA 02114
FAX NO. (617) 626-1181
- DEP: Lealdon Langley, Director of Wetlands and Waterways
Program
Department of Environmental Protection
One Winter Street Floor

Boston,, MA 02108
FAX NO. (617) 292-5696

- DFWELE: Paul Diodati, Director
Division of Marine Fisheries
251 Causeway Street, Suite 400
Boston, MA 021 14
FAX NO. (617) 626-1509

8. All notices or other communications required or permitted to be given under this MOA shall be in writing, signed by a duly authorized representative of the Parties, and shall be deemed delivered if: (i) forwarded by facsimile transmission to the attention of the designated person at the fax numbers indicated above, and mailed, postage prepaid, by regular U.S. mail, to the persons and addresses above, or (ii) delivered by hand or by recognized overnight delivery service (with evidence of receipt) to the principal office of the intended party, as indicated above, unless such address or facsimile number is otherwise designated by written notice to the other Party.


9. This MOA, or any part thereof, may be amended from time to time in a writing duly authorized and executed by the Parties.

10. The provisions of this MOA shall be binding upon, and shall inure to the benefit of, the successors and assigns of the Parties.


11. This MOA shall be effective as of the date first set fourth above, and shall terminate upon completion of the activities described in the MOA, as determined in writing by the Parties.

Executed as a sealed instrument by the duly authorized representatives of EOEa, DEP and DFWELE as of the day first set forth above.

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS:


Ellen Roy Herzfelder, Secretary

DEPARTMENT OF ENVIRONMENTAL PROTECTION:


Edward P. Kunce, Acting Commissioner

DEPARTMENT OF FISHERIES, WILDLIFE & ENVIRONMENTAL LAW
ENFORCEMENT:


David M. Peters, Commissioner

APPENDIX B: Summary of Diver and Video Observations on Three Sections of Exposed Pipe (August 11, 2003)

Pipe Section 1: At the southern-most of the three sections (500'), 5 divers observed from 6 to 9 lobsters each and most were described as sublegal sized. Other species noted were winter flounder and crabs. Habitats encountered included silty sand, cobble, clay, scattered rocks, and kelp. It was not possible to survey transects perpendicular to this section of the pipeline due to excessive current.

Diver-operated video of the first pipeline section shows the strong current encountered by divers. Visibility was poor along this section. Due to visibility and image quality, only megafauna (lobsters, cancer crabs, sea stars) were identified and enumerated. Organisms were counted as they appeared on the video screen, but densities were not estimated due to compromised video quality.

A description derived from the video noted that:

- Kelp was prevalent along the sides of the pipe in large patches and also occurred as sparsely-spaced single blades away from the pipe.
- Lobsters (6) were observed in and around the kelp along the pipeline.
- There were many sea stars, *Asterias sp.* (26) and blood stars (2) on and around the pipe.
- Cancer crabs (8) were observed around the pipe.

Pipe Section 2: The second pipeline section (500 ft.) had much better visibility and considerably less current velocity. Five divers reported the following observations:

Lobsters (mostly sublegal) were found under the pipe (14), in spoil piles (20), in traps along pipeline (12), in the vicinity of the pipe (12), and outside the area of the pipe (12). Other species noted were winter flounder, fluke (1), cunner, cod (juvenile), and blue mussels.

Habitats/sediment types encountered included clay/rock, high quality cobble, shell shack, spoil piles created by jetting, and kelp (high quality habitat was reported as impacted).

The video of the second section is higher quality. Unlike the video of the first section, it shows that kelp grew on the top and the sides of the pipe and was also prevalent adjacent to the pipe. Other general observations included:

- More fish were observed in this section, but it is unclear whether this was due to actual abundance differences or increased visibility at this site.
- There appeared to be more attached epifauna on and around the pipe in this section compared to the first (5+ sea vase).
- Approximately the same number of lobster were observed at the second section (7) as at the first. Lobsters here were seen using available space under the pipe (where elevated from the bottom). There were also two lobster traps observed near the pipe which had three (3) entrapped lobsters and two (2) adjacent to the traps.
- There were more cancer crabs (20) observed at this section of the pipeline.
- Fewer sea stars were present compared to the first section.

In general, there were more species identifiable at the second section which may in part have been due to increased visibility, making species easier to see in the video. However, based on these observations, it seems that the first section of the pipeline had organisms and growth patterns consistent with a high current regime. Observations of the second section, with kelp growing on the pipe (not just alongside) and more small epifauna, appear consistent with a slower current environment.

Pipe Section 3: As noted earlier, the northernmost of the three sections of exposed pipe (1800 ft.) was not surveyed during the short work window due to unsafe conditions.

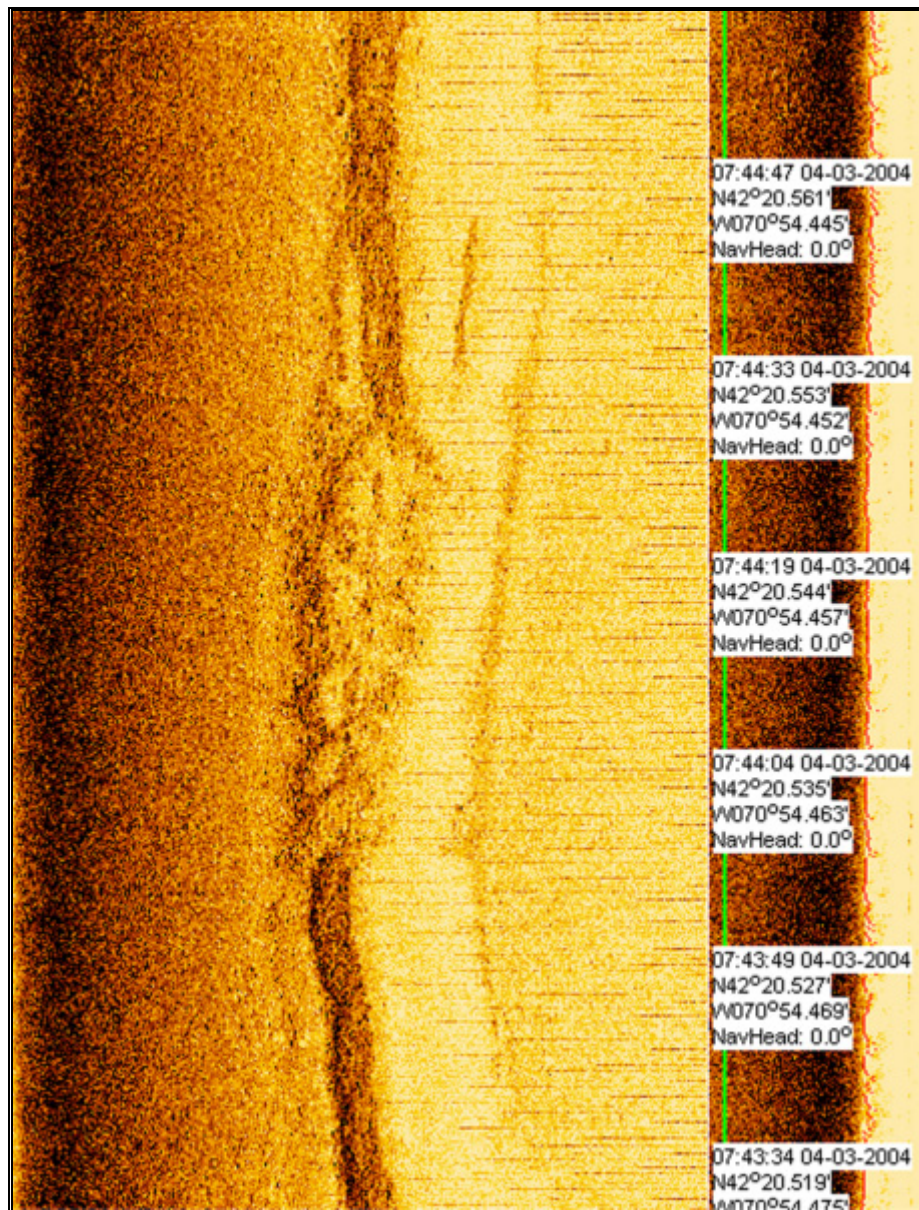
APPENDIX C: Sonar Images and ROV Video Records from Selected Sites

ROV Dive Sites of 15 June 2004 (Four dives were completed)

C-01-02Dive1,06 (Sonar record source:hubsouth1,04/08/04)

Sonar Record Description for Dive 1: The trench path is bordered by smooth natural seabottom. The path is distinct and appears to contain cobble fill. The top and lower segments appear contained to the trench and plowed area. The mid-segment appears to be post-plowing fill. The width of the record is 75m.

Video Record Description for Dive 1: (on the NE section of the northernmost August 2003 DMF dive site.) This site is just east of Blackrock Channel. For this cruise it was designated C-01, C-02. Coordinates: 42 20.5N / 070 54.4W; VHS taped records showed man-placed cobble, natural bottom and some marine life.



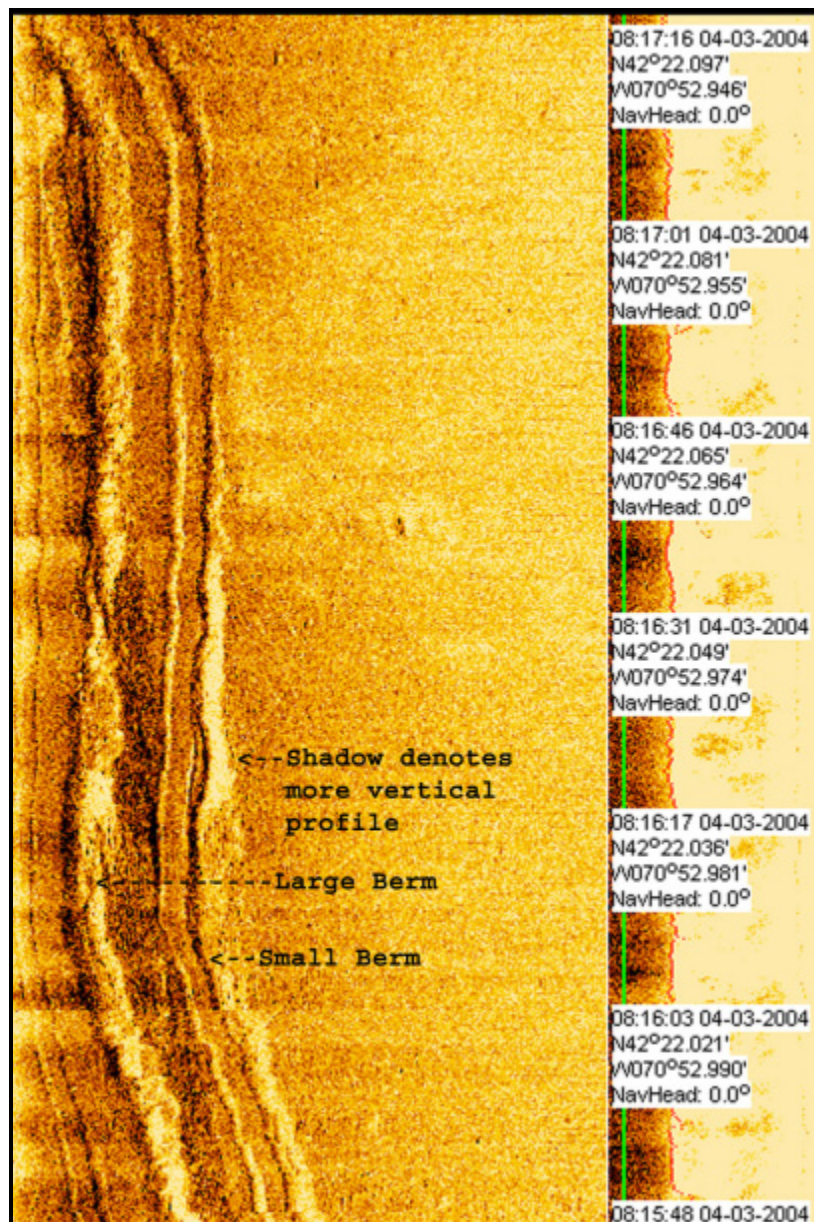
Video Record Description for Dive 2: Nantasket Road, site designated C-05; Coordinates: 42 18.6N / 070 56.1W. No remains of the trenched bottom were identified. The ROV dive was terminated early because of current.

Video Record Description for Dive 3: Off the "Graves" designated B-07. Coordinates: 42 22.5N / 070 52.7W. Trenched area with cobble and berms paralleling the trenched path.

B-6Dive4,0615 (Sonar record source:hubsouth1,04/08/04)

Sonar Record Description for Dive 4: The clear insonification of the trench and plowed area is 25m wide. Two low berms (<1m high) lay inside and outside of the skid path and one major berm (>1m) lies in the middle of the path. Sea conditions produced some heave effect on the record; this in evidence by a slight wobbling effect in the record.

Video Record Description for Dive 4: Just east of the Dive 3 site; designated as B-6. Coordinates: 42 22.1N / 070 52.9W. Trenched area and berms; cobble and clay.

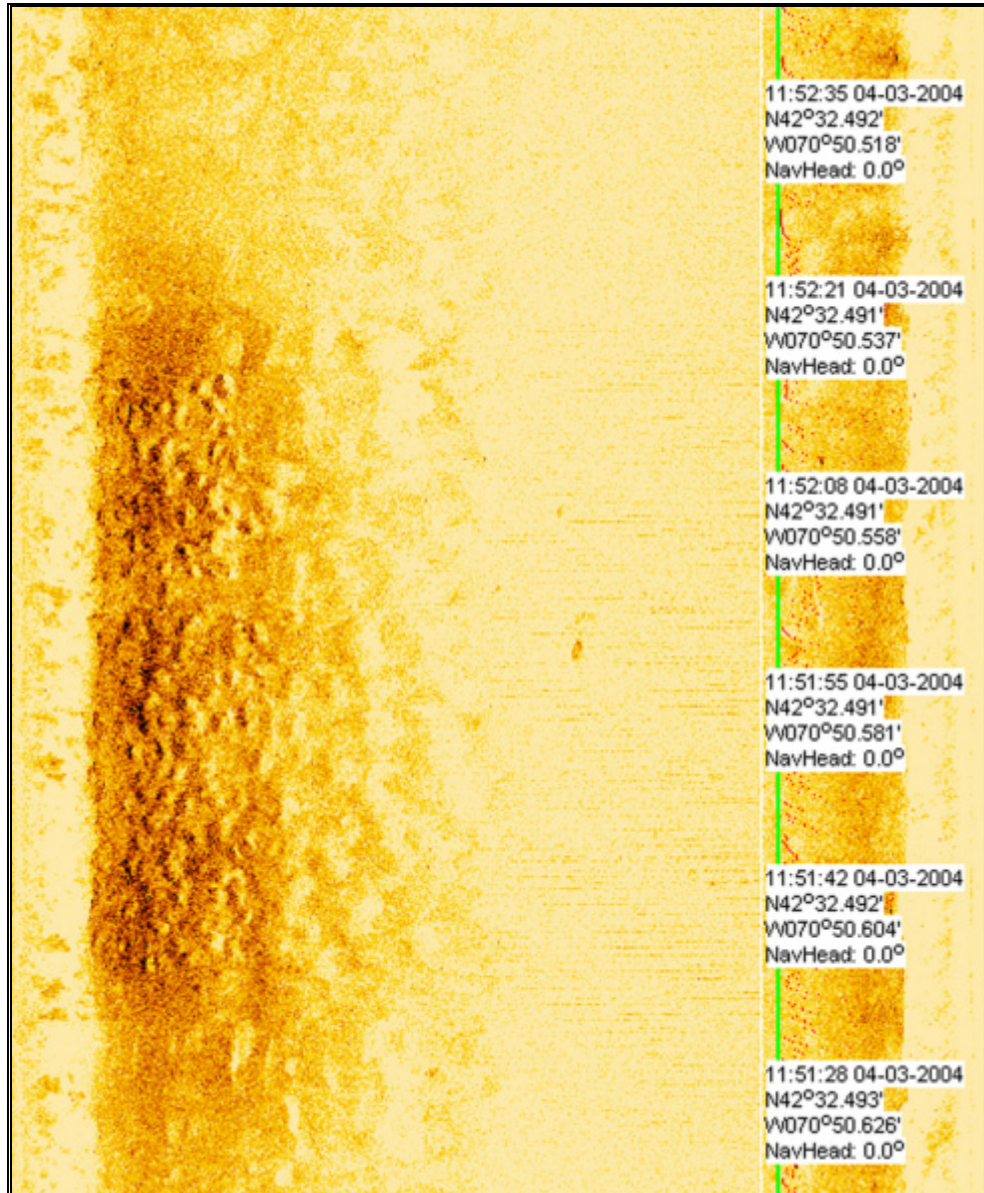


ROV Dive Sites of 16 June 2004 (Five dives were completed)

C-07Dive1,0616: (Sonar record source:hubsouth1,04/08/04)

Sonar Record Description for Dive 1: This is a 500kHz record showing a fill area with the dimensions of 130m by 35m. Some of the irregular fill shows a darker return; this is fill that has an upward face to the sonar source (sloping up as it is further away from the sonar source). The lighter and less defined fill further to the right is sloping down toward the natural seabottom depth.

Video Record Description for Dive 1: Site designated as C-07; Coordinates: 42 32.4N / 070 50.79W
Previously described as an area that was filled and a transition zone. Little was seen, at first, that may relate to the trenching but near the end of the dive we viewed a major disturbed depression that had collected algae, Laminaria, etc.



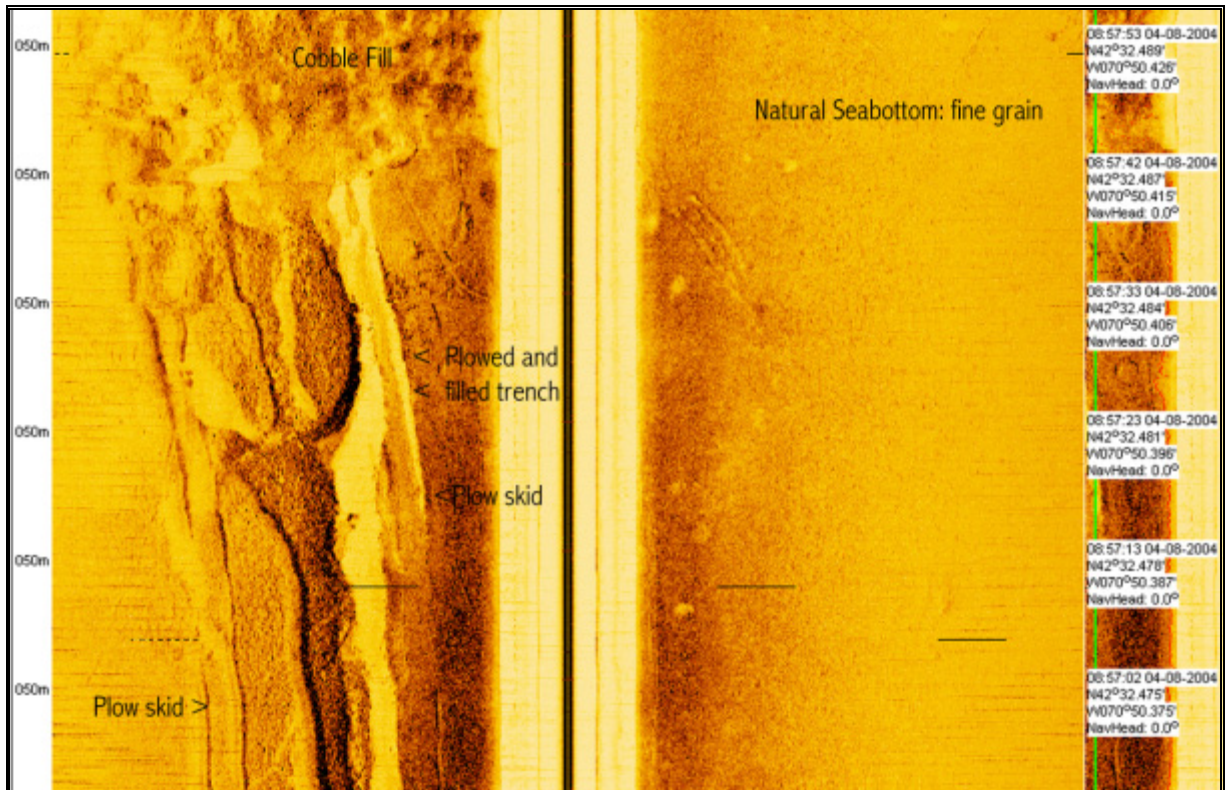
C-08, Dive2, 0616:

(Sonar record source:hubsouth1,04/08/04)

Sonar Record Description for Dive 2: The upper part of the picture show the area that was covered with fill. The lower part shows an area that was plowed. Darker returns generally denote a ridge or upslope feature. The lighter returns are depressions or gulleys where there is little or no sonar echo returned. The width of this plowed area is about 24m.

Video Record Description Dive 2: Site designated as C-08 Coordinates: 42 32.5N / 070 50.4W

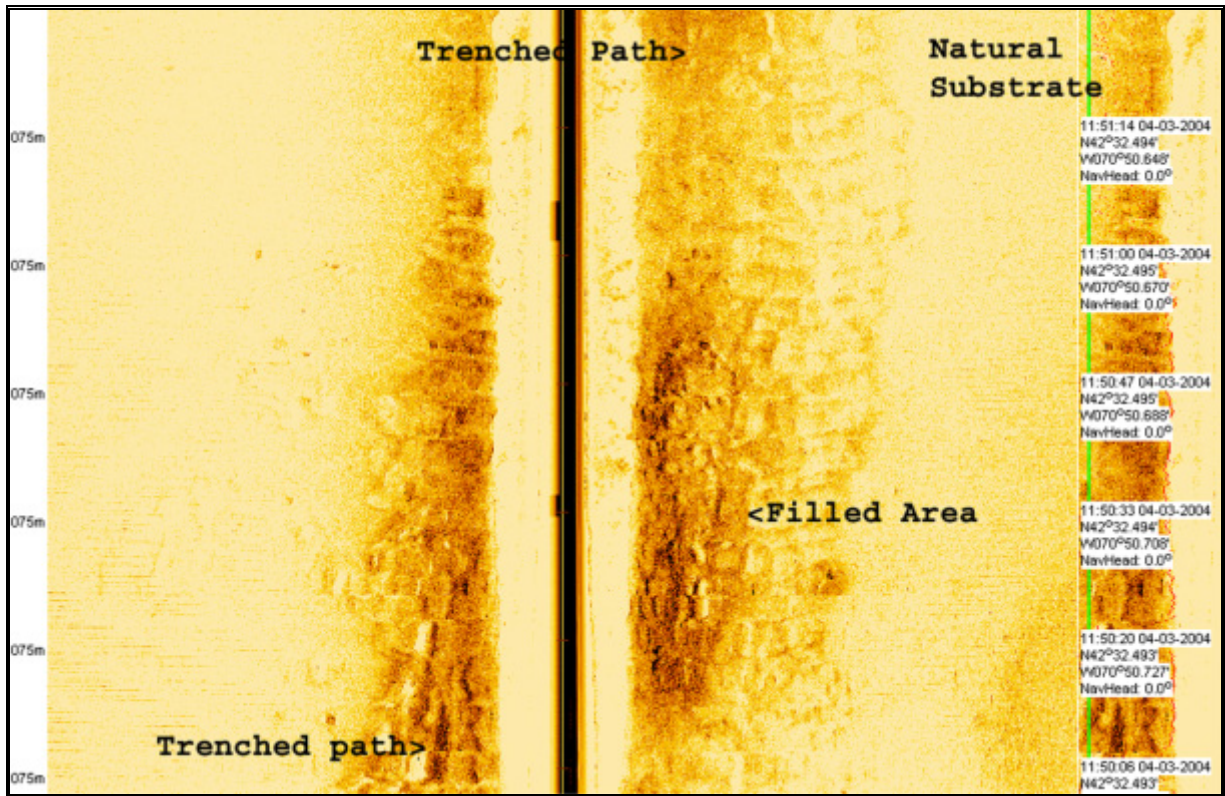
This was a site previously labeled as complex. The trenching left the site quite disturbed and of varying depth. The tape recording shows much cobble and depressions and little marine life.



C-09Dive3,0616: (Sonar record source:hubsouth1, 04/08/04)

Sonar Record Description for Dive 3: The fill area depicted measures about 83m by 28m. It represents only a portion of the fill in that immediate area. The seabottom shown at the sides of the picture is the natural flat and less irregular substrate.

Video Record Description Dive 3: Site designated as C-09 Coordinates: 42 32.35N / 070 50.66W
A previously designated site for optical survey. It consisted of cobble with more colonization of attached bryozoans and hydroids than previously seen cobble. Cobble berms and depressions viewed.

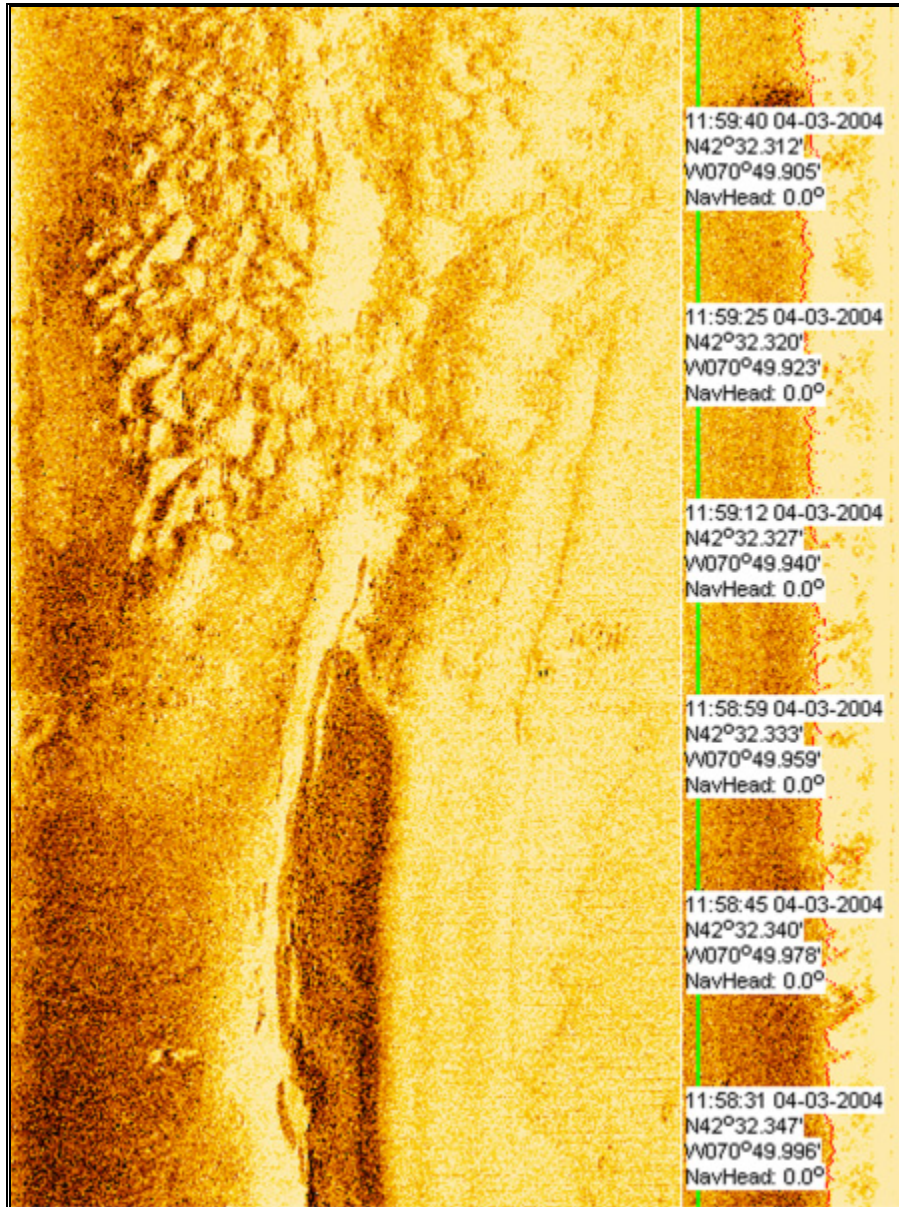


C-10Dive4,0616: (Sonar record source:hubsouth1,04/08/04)

Sonar Record Description for Dive 4: The width of this record is 75m. The upper portion of the record is an area that was covered with fill. The lower portion shows the remnants of the plow activity. The left part of the record, that is darker, shows more of an upslope as it progresses to the right and then a downslope progression further to the right. In the plowed area the upslope appears to change to a downslope along the center of the plowed path.

Video Record Description Dive 4: Site designated as C-10 Coordinates: 42 32.3N / 070 49.9W

The sonar survey described this area as a transition zone that was probably filled after trenching. The video showed a good profile of the trench, sandy bottom and cobble.



C-14Dive5,0616

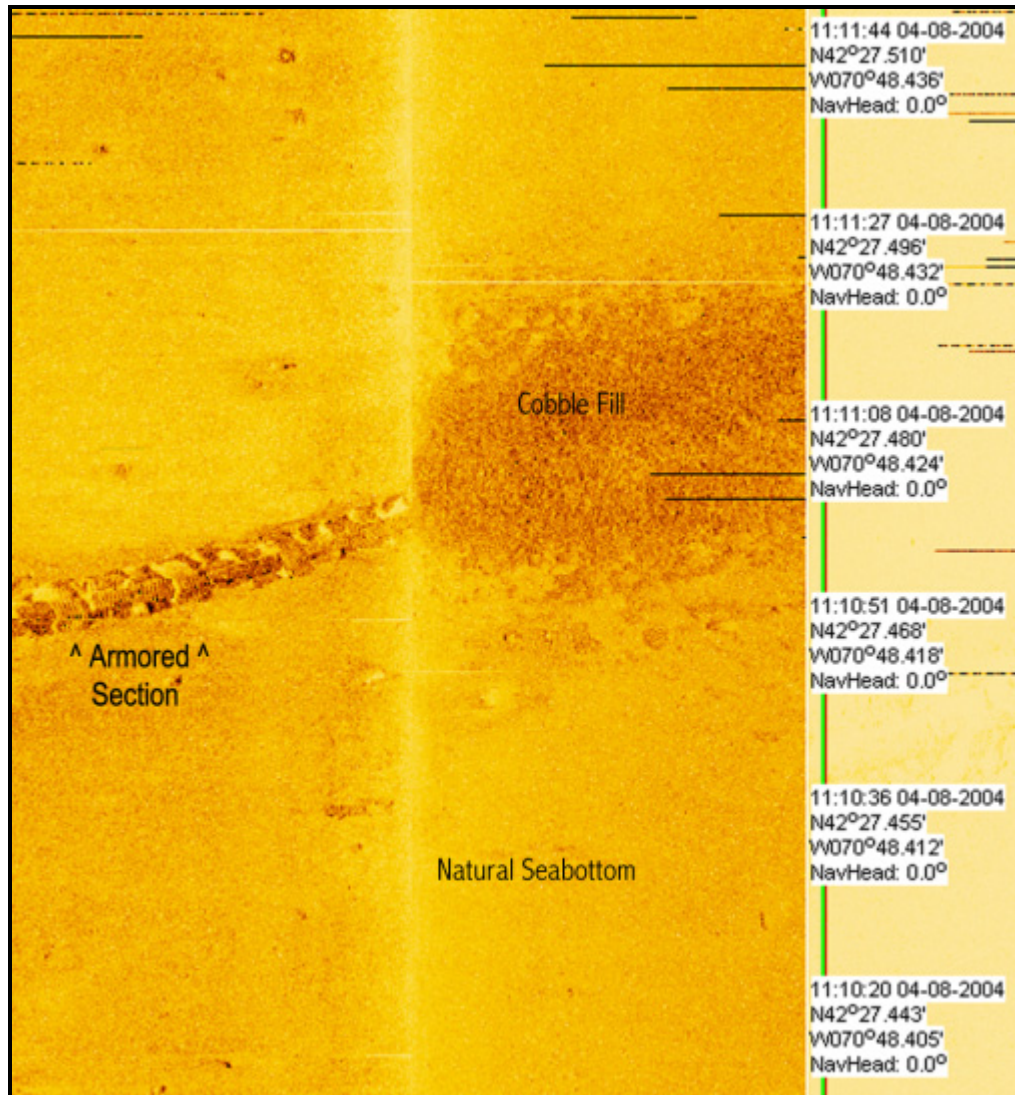
(Sonar record source:hubsouth1,04/08/04)

Sonar Record Description for Dive 5: The armored section is to the left and the cobble fill on the north end (right) of the armor. Although the sonar image is 75m range, the pattern of the concrete armor blocks is evident.

Video Record Description Dive 5: Site designated as C-14; the armored vicinity.

Coordinates: 42 27.43N / 070 48.46W

The records show natural bottom and armored sections. The latter is concrete “blocks” connected to form mats. Some cunners, a sculpin and a flounder were viewed; no lobsters or other crustaceans.



ROV Dive Sites of 17 June 2004 (Five dives were completed)

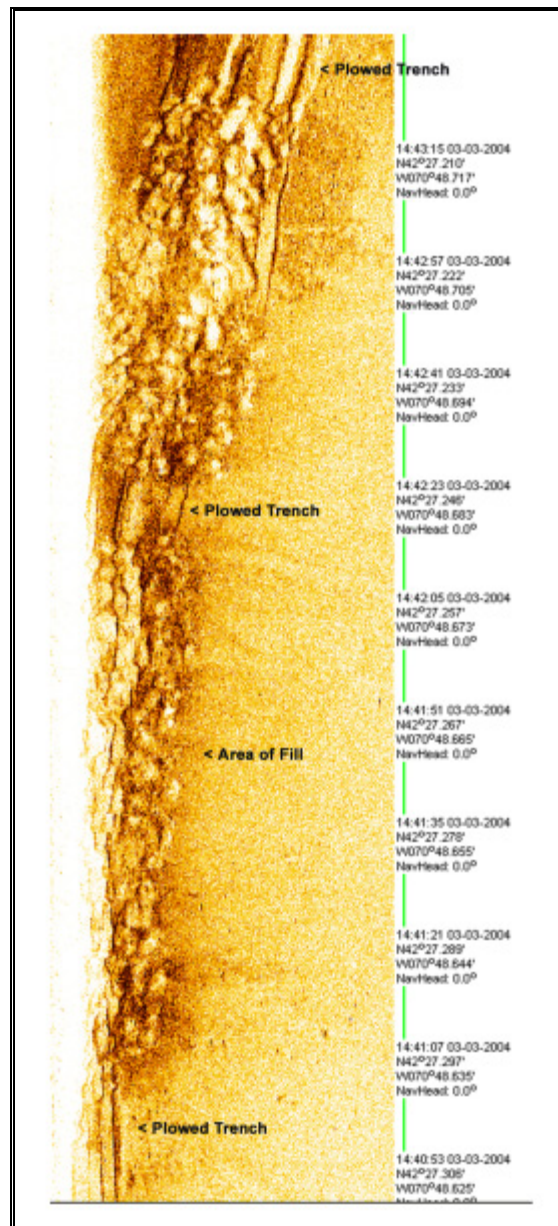
C17-18Dive1,0617

(Sonar record source:hubsouth1,04/08/04)

Sonar Record Description for Dive 1: This is one of two similar sites. The sonar record is a partial image of the site. Some of the fill is to the left and out of the insonified area of this record. The image shows two mounds of cobble; each measures about 100m long by 32m wide (as seen in the record). There is a plowed area between the cobble mounds which is about 18m long and 19m wide.

Video Record Description for Dive 1: Site designated as C-17, C-18 Coordinates: 42 27.3N 070 48.7W

This site was previously recommended for a video survey as it represented an area that was a combination of plowed and filled with cobble. The sonar showed clear examples of this representation. The ROV dive viewed good representations of cobble and natural bottom. Some marine life was seen. This included ocean pout, sculpin, cunner, and a lobster.

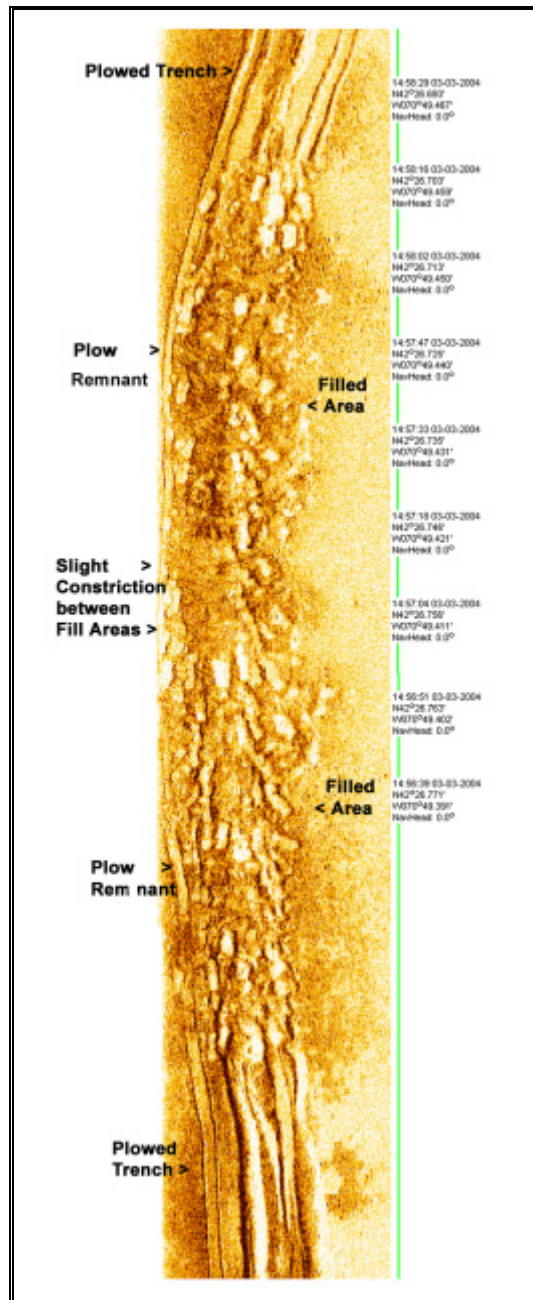


C19-20, Dive2, 0617

(Sonar record source:hubsouth1,04/08/04)

Sonar Record Description for Dive 2: This site is similar to the previous site: it has two cobble filled mounds along the trenched area. The difference is that the mounds are slightly separated with essentially no plowed trench path between them. Some remnants of the plow track are seen along the left side of the mounds.

Video Record Description for Dive 2: Site designated as C-19, C-20 Coordinates: 42 27.1N / 070 48.9W
This site is adjacent to the Dive 1 site and reflects the same characteristics as previously seen by sonar. The ROV dive saw natural bottom, some near vertical relief with cobble and some cunner.

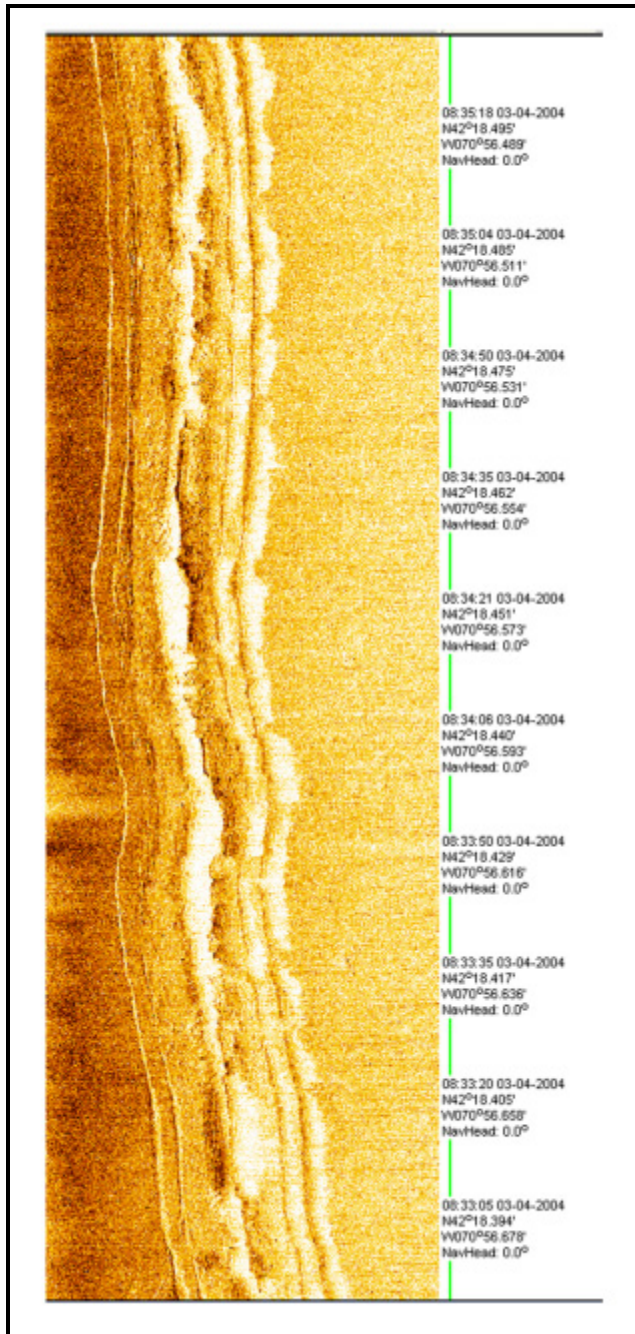


A20, Dive3, 0617 (Sonar record source: HubweymouthtoHull, 03/2004

Sonar Record Description for Dive 3: Coordinates: 42 18.4N / 070 56.6W

A plowed trench section in the shallow Nantasket Road waters. The plowed section is complex with berms and depressions linear to the path of the plow.

Video Record Description for Dive 3: This site was previously designated as A-20 and is in Nantasket Road. Coordinates: 42 18.4N / 070 56.6W. It was previously described, via sonar survey, as complex and interesting as related to the trenching. The ROV showed good trench after-effect profile with one lobster, a crab, and a minor variety of fish, including a chance “swim-by” by a sea raven.



A25, Dive4, 0617 (Sonar record source: HubweymouthtoHull, 03/2004)

Sonar Record Description for Dive: Coordinates: 42 18.5N / 070 56.4W

A plowed trench section in the shallow Nantasket Road waters. This site is located next and NE of "A20". The A25 site has sand and gravel size substrate that shows some vertical features. Some of these are described. The plowed area is about 25m wide.

Video Record Description for Dive 4: This is A-25 as previously recorded. Coordinates: 42 18N / 070 56W
Although little growth was evident on the cobble and sea bottom, a modest amount of marine life was seen: skate, cunners, and crabs.

